

# Epi Research Report

New York City Department of Health and Mental Hygiene

October 2013

## Matching New York City Viral Hepatitis, Tuberculosis, Sexually Transmitted Diseases and HIV Surveillance Data, 2000-2010

*Viral hepatitis (hepatitis B and C), tuberculosis (TB), HIV and other sexually transmitted diseases (STDs), including chlamydia, gonorrhea and syphilis, often affect the same individuals and communities. These diseases share risk factors and modes of transmission,<sup>1</sup> and the interaction of two or more of these diseases within one individual can increase illness and accelerate time to death. Describing the distribution of these diseases in New York City can help identify communities most at risk and target programs to manage and prevent the spread of infections.*

The Centers for Disease Control and Prevention's (CDC) Program Collaboration and Service Integration (PCSI)<sup>2</sup> initiative funded work to identify risk groups, and to facilitate delivery of integrated services to the public in areas of the city most affected by viral hepatitis, TB, STDs and HIV. In 2012, the NYC Health Department matched its surveillance data on viral hepatitis, TB, STDs and HIV from 2000-2010, and also matched these data with vital

statistics death data from 2000-2011. The Health Department is working to better understand risk factors for having two or more of these diseases and to design programs and activities that simultaneously address multiple diseases. In this report, we describe the methods and general findings from this project and highlight the key demographic and risk factor information for the most common overlaps in disease.

### Key Findings:

- The majority of people with both HIV and syphilis are men who have sex with men (MSM).
- The majority of HIV/hepatitis C co-infected cases are among people with a history of injection drug use (IDU).
- Rates of hepatitis B and hepatitis C among people with HIV are highest in neighborhoods where 30% or more of residents live below the federal poverty level (FPL).
- More than one in 10 New Yorkers with HIV had another STD between 2000 and 2010.
- People born outside of the United States are the largest group affected by both TB and hepatitis B.
- People with two or more diseases were more likely to have died between 2000 and 2011 than those with only one disease.

1 Dowell D, Gaffga NH, Weinstock H, Peterman TA. Integration of surveillance for STDs, HIV, hepatitis and TB: a survey of U.S. STD control programs. *Public Health Rep.* 2009; 124(Suppl 2):31-38.

2 Program Collaboration and Service Integration (PCSI) initiative. Centers for Disease Control Web site. Available at: <http://www.cdc.gov/nchstp/programintegration/About.htm>. Accessed September 6, 2013.

## About the Data

HIV, syphilis, gonorrhea, chlamydia, hepatitis B, hepatitis C and TB must be reported to the Health Department according to New York State Public Health Law and the New York City Health Code. Both medical providers and laboratories are required to report. Reports are maintained in separate surveillance databases by disease grouping. For some diseases, Health Department staff collect additional information when conducting case investigations, and these data are added to enrich the surveillance databases. Of the matched surveillance data, the TB and HIV databases have the most complete demographic information, as well as data on risk factors and transmission risk. This is because additional information is collected from medical record review and patient interviews. Because of this more complete data, when looking

at specific combinations of diseases for this report, we used HIV and TB as reference groups to allow for comparison by risk factor and race/ethnicity.

## Data Match

Data from Health Department surveillance databases for each of the seven diseases (Table 1) and vital statistics records of deaths occurring in NYC were linked in SAS 9.2 (Cary, NC). Records were linked across databases using increasingly flexible algorithms, called keys, made up of an exact character correspondence between variables. The 14 keys used were based on combinations of first name, last name, date of birth and social security number. Each record in a dataset was compared against each record in the other dataset, starting with key 1. If there was no match on key 1, the records were evaluated again on key 2,

then key 3, etc., with subsequent keys becoming progressively more flexible to allow for variations in spelling and typographic errors. Once the match was completed, all identifying information was removed to protect confidentiality.<sup>3</sup>

## Overall Results

After matching, 840,248 unique people were identified as having at least one of the seven diseases. The number of people with each disease ranged from 11,875 with TB to 366,409 with chlamydia (Table 2). Though most individuals had only one disease (87%), 13% had multiple diseases.

People with syphilis were the most likely to have had another disease (64%) (Table 2) during the time period, and people with hepatitis B were the least likely to have been diagnosed with another disease (11%).

**Table 1** Definitions of cases included in the match

Disease	Cases included	Time period
TB	New cases of active TB	Reported between January 1, 2000 and December 31, 2010
Hepatitis B	Existing and new cases of chronic hepatitis B	Alive as of January 1, 2000 and reported on or at any time before December 31, 2010
Hepatitis C	Existing and new cases of chronic hepatitis C	Alive as of January 1, 2000 and reported on or at any time before December 31, 2010
Chlamydia	New cases of chlamydia	Reported between January 1, 2000 and December 31, 2010
Gonorrhea	New cases of gonorrhea	Reported between January 1, 2000 and December 31, 2010
Syphilis	New cases of primary, secondary and early latent syphilis	Reported between January 1, 2000 and December 31, 2010
HIV	Existing and new cases of HIV and AIDS	Alive as of January 1, 2000 and reported on or at any time before December 31, 2010

3 Drobnik A, Pinchoff J, Bushnell G, et al. Matching HIV, tuberculosis, viral hepatitis and STD surveillance data, 2000-2010: identification of infectious disease syndemics in New York City. *J Public Health Manag Pract*, in press.

About one in six New Yorkers with HIV was co-infected with hepatitis C (16%) (Table 3). HIV

was the most common additional disease for people with syphilis (49%), hepatitis C (15%), TB

(14%) and hepatitis B (5%). Nearly half (46%) of individuals with gonorrhea infections during the time period also had chlamydia during the time period.

**Table 2** Number of people with each disease, and number with at least one additional disease, NYC, 2000-2010

Disease	Total people with disease	People with at least one additional disease
TB	11,875	2,543 (21%)
Hepatitis B	155,959	16,911 (11%)
Hepatitis C	157,750	31,274 (20%)
Chlamydia	366,409	58,906 (16%)
Gonorrhea	109,050	56,725 (52%)
Syphilis	14,216	9,061 (64%)
HIV	140,606	44,060 (31%)

Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

### Mortality

People with more than one of the seven diseases during the time period were more likely to have died regardless of cause, than people with only one disease (Table 4). Of those who had just one disease, a greater proportion of people with HIV died during the time period (16%), followed by people with

**Table 3** Proportion of people with each disease matching to each of the other diseases, NYC, 2000-2010

Disease	# of people	Percent matching to:						
		TB	Hepatitis B	Hepatitis C	Chlamydia	Gonorrhea	Syphilis	HIV
TB	11,875	-	4%	6%	2%	1%	<1%	14%
Hepatitis B	155,959	<1%	-	4%	2%	1%	1%	5%
Hepatitis C	157,750	<1%	4%	-	1%	1%	1%	15%
Chlamydia	366,409	<1%	1%	1%	-	14%	1%	2%
Gonorrhea	109,050	<1%	1%	1%	46%	-	3%	7%
Syphilis	14,216	<1%	6%	8%	18%	21%	-	49%
HIV	140,606	1%	6%	16%	5%	6%	5%	-

Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Table 4** Deaths\* among people with a single disease vs. deaths among people with multiple diseases, NYC, 2000-2011

Disease	People with single disease	People with single disease who died	People with multiple diseases	People with multiple diseases who died
TB	9,332	1,194 (13%)	2,543	766 (30%)
Hepatitis B	139,048	5,812 (4%)	16,911	3,352 (20%)
Hepatitis C	126,476	18,250 (14%)	31,274	9,334 (30%)
Chlamydia	307,503	1,601 (<1%)	58,906	898 (2%)
Gonorrhea	52,325	589 (1%)	56,725	994 (2%)
Syphilis	5,155	133 (3%)	9,061	416 (5%)
HIV	96,546	15,554 (16%)	44,060	10,674 (24%)

Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

\* Not age-adjusted

hepatitis C (14%) and TB (13%). Among persons with two or more diseases, nearly one-third of people with TB and nearly one-third of people with hepatitis C (30%) died, while 24% of people with HIV and another disease and 20% of people with hepatitis B and another disease died.

### HIV and Hepatitis C

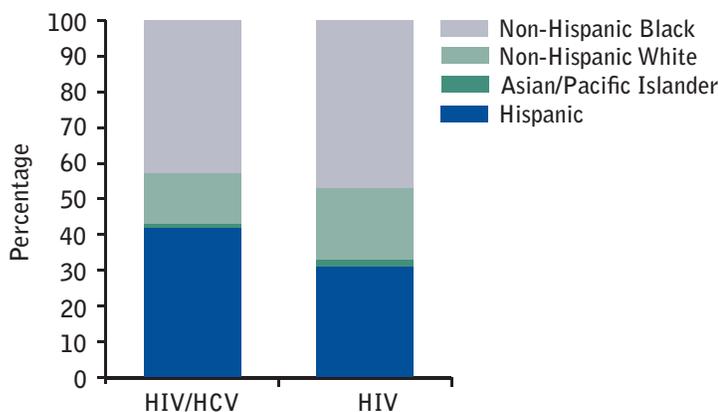
HIV and hepatitis C virus (HCV) are both transmitted by blood and share several risk factors. Studies have shown that injection drug use (IDU) is the most common risk factor for HIV/hepatitis C co-infection,<sup>4</sup> and a history of incarceration is also common among people with HIV and hepatitis C.<sup>5</sup> HIV infection leads to faster disease progression among people with chronic hepatitis C,<sup>6</sup> increasing risk of liver cirrhosis and hepatocellular carcinoma. In addition, hepatitis C is one of the leading causes of death among people living with HIV.<sup>7</sup> Current recommendations are that all HIV-infected individuals be tested for hepatitis C annually.<sup>8,9</sup>

A larger proportion of New Yorkers co-infected with HIV and hepatitis C were Hispanic than those with only HIV (42% vs. 31%) (Figure 1). HIV/hepatitis C

co-infected individuals were about three times as likely to report IDU (60% vs. 16%) and were less likely to report being men who

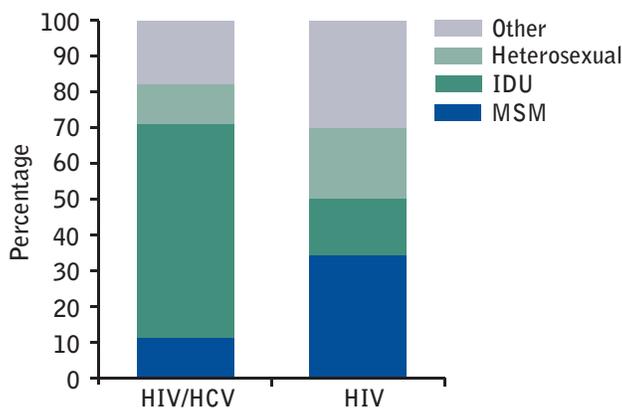
have sex with men (MSM) (11% vs. 33%) than those with HIV who were not hepatitis C co-infected (Figure 2).

**Figure 1 Race/ethnicity of people with HIV/hepatitis C (HCV) co-infection and HIV, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Figure 2 HIV transmission risk\* of people with HIV/hepatitis C (HCV) co-infection and HIV, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

\* Risk categories are mutually exclusive. Other includes unknown risk, perinatal transmission, hemophilia, receipt of blood transfusion or transplant, and non-perinatal risk in pediatric cases.

4 Speers S, Monina Klevens R, Vonderwahl C, et al. Electronic matching of HIV/AIDS and hepatitis C surveillance registries in three states. *Public Health Rep.* 2011;126(3):344-348.  
 5 Gough E, Kempf MC, Graham L, et al. HIV and hepatitis B and C incidence rates in US correctional facility populations and high risk groups: a systematic review and meta-analysis. *BMC Public Health.* 2010;10:777.  
 6 Balagopal A, Philip FH, Astemborski J, et al. Human immunodeficiency virus-related microbial translocation and progression of hepatitis C. *Gastroenterology.* 2008;135(1):226-233.  
 7 Adih WK, Selik RM, Hu X. Trends in diseases reported on US death certificates that mentioned HIV infection, 1996-2006. *J Int Assoc Provid AIDS Care.* 2011;10(1):5-11.  
 8 Kaplan JE, Benson C, Holmes KK, Brooks JT, Pau A, Masur H. Guidelines for prevention and treatment of opportunistic infections in HIV-infected adults and adolescents: recommendations from CDC, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America. *MMWR Recomm Rep.* 2009;58(RR-4):1-207.  
 9 Aberg JA, Kaplan JE, Libman H, et al. Primary care guidelines for the management of persons infected with human immunodeficiency virus: 2009 update by the HIV Medicine Association of the Infectious Diseases Society of America. *Clin Infect Dis.* 2009;49(5):651-681.

### HIV and Hepatitis B

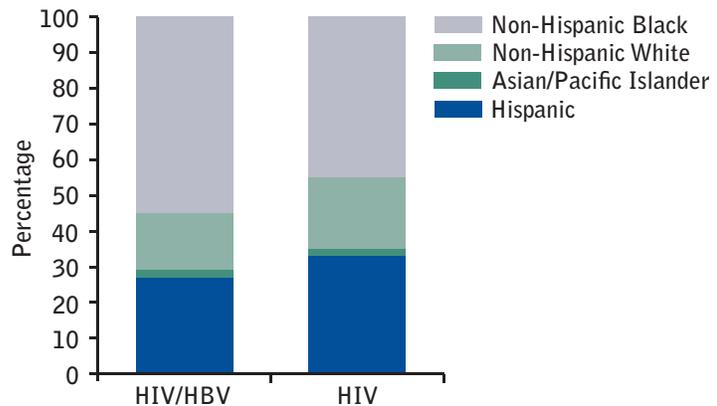
Like HIV, hepatitis B virus (HBV) can be transmitted by blood or sexual fluids, and can be passed from mother to infant at birth. Hepatitis B infection is more likely to become chronic in HIV-infected individuals,<sup>10</sup> and co-infected people are at an increased risk for liver-related cirrhosis and hepatocellular carcinoma.<sup>11</sup>

Routine hepatitis B testing is recommended for high-risk populations, including foreign-born people from countries with high hepatitis B prevalence and persons living with HIV.<sup>12</sup> Hepatitis B vaccination is also recommended

for people with HIV, as well as groups at risk for HIV such as MSM and IDU.<sup>8</sup>

A greater proportion of New Yorkers co-infected with HIV and hepatitis B were non-Hispanic black than of those with only HIV (55% vs. 45%) – representing more than half of the co-infected population – and a smaller proportion were Hispanic (26% vs. 33%) or non-Hispanic white (16% vs. 20%) (Figure 3). There were no differences in transmission risk factors between HIV and hepatitis B co-infected people and those with only HIV (data not shown).

**Figure 3 Race/ethnicity of people with HIV/hepatitis B (HBV) co-infection and HIV, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

10 Thio CL. Hepatitis B and human immunodeficiency virus co-infection. *Hepatology*. 2009; 49(5 Suppl):S138-145.

11 Thio CL, Seaberg EC, Skolasky R Jr, et al. HIV-1, hepatitis B virus, and risk of liver-related mortality in the Multicenter Cohort Study (MACS). *Lancet*. 2002;360(9349):1921-1926.

12 Centers for Disease Control and Prevention. Recommendations for identification and public health management of persons with chronic hepatitis B virus infection. *MMWR Recomm Rep*. 2008; 57(RR-8):1-20.

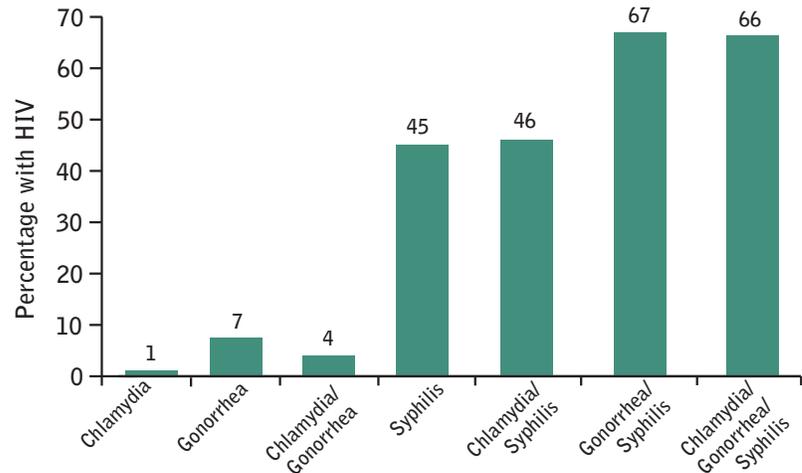
## HIV and STDs

Infection with other STDs can facilitate HIV transmission and vice versa.<sup>13</sup> Of the 140,606 persons in the HIV dataset, 16,307 (12%) also had at least one chlamydia, gonorrhea or syphilis infection during the time period; of those 13,866 (85%) had an STD diagnosis after their HIV diagnosis.

HIV infection was much more common among New Yorkers with at least one diagnosis of syphilis during the time period (45%) than among those with a gonorrhea (7%) or chlamydia (1%) diagnosis, or with both a chlamydia and a gonorrhea diagnosis (4%). People with both syphilis and another STD diagnosis were more likely to also have HIV. Nearly two thirds (66%) of those with all three STDs during the time period were also HIV infected (Figure 4).

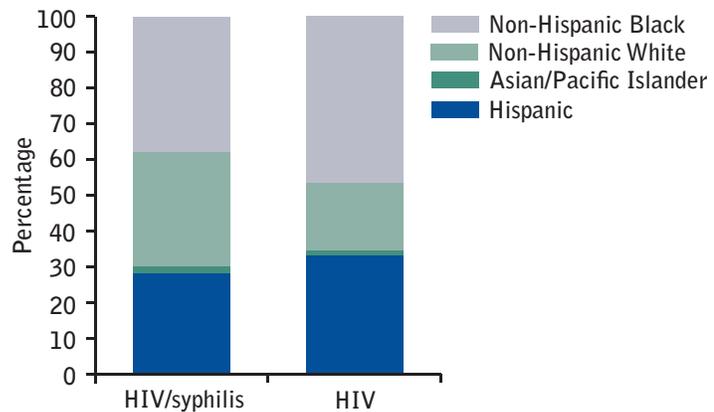
A greater proportion of New Yorkers with HIV who had a syphilis diagnosis were male (97% vs. 69%, data not shown), non-Hispanic white (32% vs. 19%), and MSM (78% vs. 27%) compared to those without a syphilis diagnosis. However, a smaller proportion reported IDU (5% vs. 24%) (Figures 5 and 6).

**Figure 4 Percentage of people with single and multiple STD diagnoses who also have HIV, NYC, 2000- 2010**



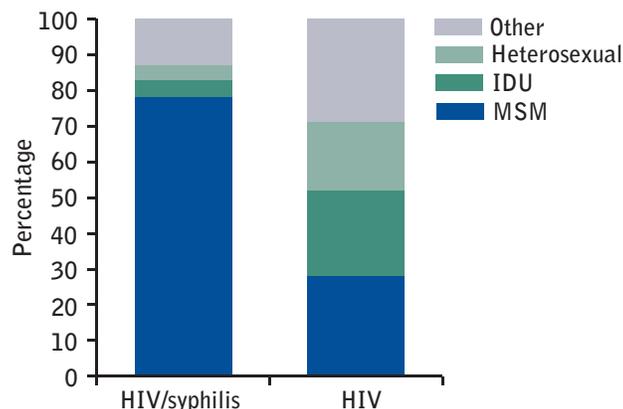
Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Figure 5 Race/ethnicity of people with HIV/syphilis and HIV, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

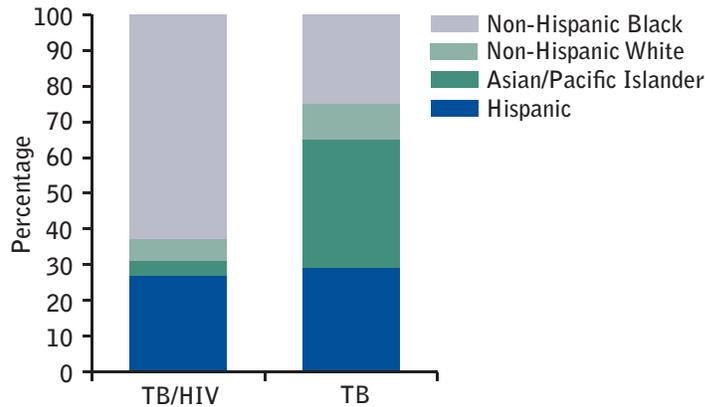
**Figure 6 HIV transmission risk\* of people with HIV/syphilis and HIV, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012  
 \* Risk categories are mutually exclusive. Other includes unknown risk, perinatal transmission, hemophilia, receipt of blood transfusion or transplant, and non-perinatal risk in pediatric cases.

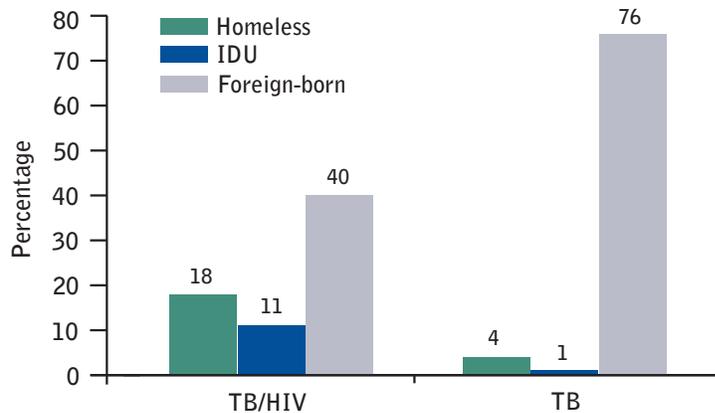
13 Wasserheit JN. Epidemiological synergy. Interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. *Sex Transm Dis.* 1992;19(2):61-77.

**Figure 7 Race/ethnicity of people with TB/HIV and TB, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Figure 8 TB risk factors\* among people with TB/HIV and TB, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012  
 Note: Homelessness is based on self-report at the time of TB diagnosis or any time during TB treatment; injection drug use (IDU) is based on self-report in the 12 months prior to TB diagnosis.

\* TB risk categories are not mutually exclusive; an individual may be included in more than one category.

## TB and HIV

Although the burden of TB is lower in the US relative to other countries, TB remains a problem in New York City, particularly for people living with HIV. HIV greatly increases the risk of progression from latent TB infection to active TB disease.<sup>14</sup> TB disease similarly accelerates the progression of HIV disease. These synergistic effects in people with TB and HIV worsen the effects of both diseases.<sup>15</sup>

About one in seven (14%) New Yorkers with TB also had HIV. In New York City, people with both HIV and TB were disproportionately non-Hispanic black compared to those with only TB (63% vs. 25%) (Figure 7).

A larger proportion of people with TB and HIV had either IDU (11% vs. 1%) or homelessness (18% vs. 4%) as a risk factor, compared with those with only TB. However, they were much less likely to be foreign-born (Figure 8).

14 Selwyn PA, Hartel D, Lewis VA, et. al. A prospective study of the risk of tuberculosis among intravenous drug users with human immunodeficiency virus infection. *N Engl J Med.* 1989; 320(9):545-50.

15 Kwan CK, Ernst JD. HIV and tuberculosis: a deadly human syndemic. *Clin Microbiol Rev.* 2011;24(2):351-376.

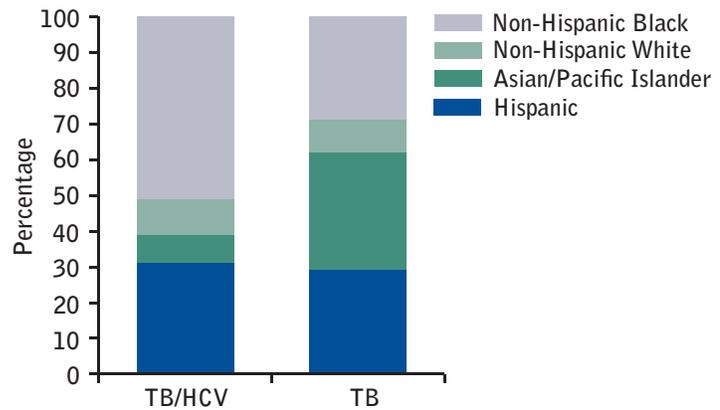
## TB and Hepatitis C

Treatment for TB can last up to a year or more, and the drugs used may be toxic to the liver, accelerating the progression of liver disease for people with hepatitis C.<sup>16,17</sup> Epidemiologically, hepatitis C and TB are both associated with homelessness, incarceration, poverty, and poor healthcare access.<sup>18-20</sup>

Among New Yorkers with a TB diagnosis between 2000 and 2010, 659 (6%) were diagnosed with hepatitis C, more than half of whom were non-Hispanic black (51%) (Figure 9).

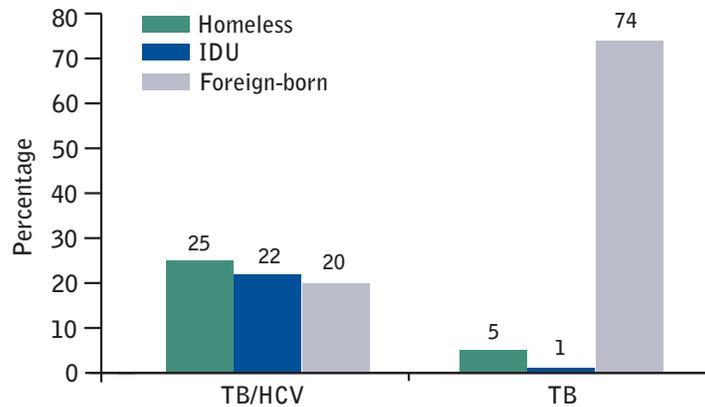
A greater proportion of individuals with TB and hepatitis C had IDU and being homeless as risk factors than those with only TB (Figure 10). However, they were much less likely to be foreign-born (20% vs. 74%).

**Figure 9 Race/ethnicity of people with TB/hepatitis C (HCV) and TB, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Figure 10 TB risk factors\* among people with TB/hepatitis C (HCV) and TB, NYC, 2000-2010**

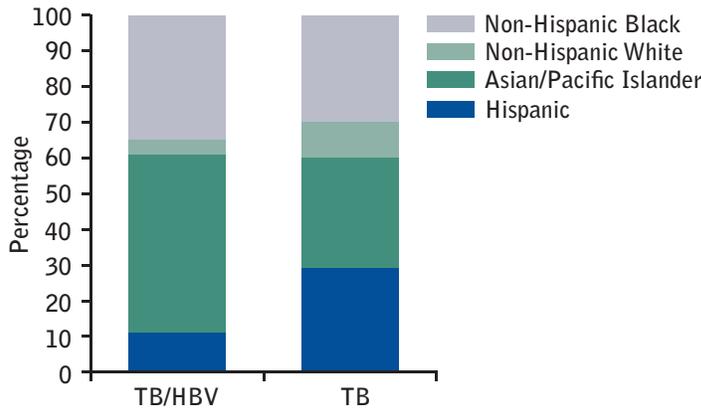


Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012  
 Note: Homelessness is based on self-report at the time of TB diagnosis or any time during TB treatment; injection drug use (IDU) is based on self-report in the 12 months prior to TB diagnosis.

\*TB risk categories are not mutually exclusive; an individual may be included in more than one category.

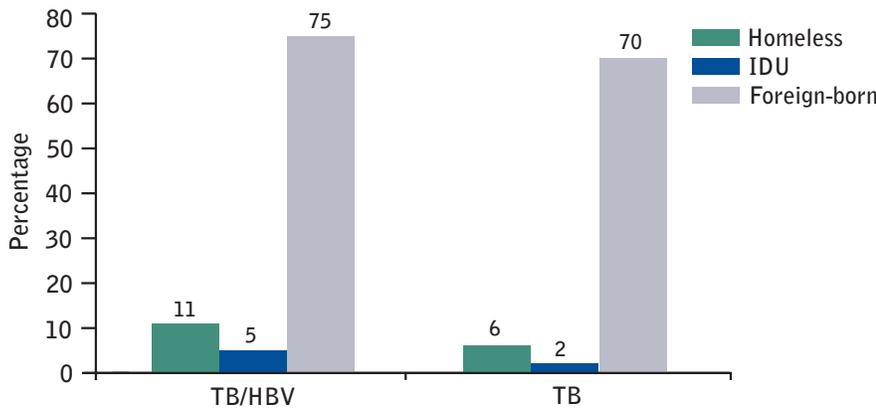
16 Chien JY, Huang RM, Wang JY, et al. Hepatitis C virus infection increases hepatitis risk during anti-tuberculosis treatment. *Int J Tuberc Lung Dis.* 2010;14(5):616-621.  
 17 Padmapriyadarsini C, Chandrabose J, Victor L, Hanna LE, Arunkumar N, Swaminathan S. Hepatitis B or hepatitis C co-infection in individuals infected with human immunodeficiency virus and effect of anti-tuberculosis drugs on liver function. *J Postgrad Med.* 2006;52:92-96.  
 18 Nguyen GC, Thuluvath PJ. Racial disparity in liver disease: biological, cultural or socioeconomic factors. *Hepatology.* 2008;47(3):1058-1066.  
 19 Feske ML, Teeter LD, Musser JM, Graviss EA. Counting the homeless: a previously incalculable tuberculosis risk and its social determinants. *Am J Public Health.* 2013;103(5):839-848.  
 20 Awofeso N. Prisons as social determinants of hepatitis C virus and tuberculosis infections. *Public Health Rep.* 2010;125:25-33.

**Figure 11 Race/ethnicity of people with TB/hepatitis B (HBV) and TB, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

**Figure 12 TB risk factors\* among people with TB/hepatitis B (HBV) and TB, NYC, 2000-2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012  
 Note: Homelessness is based on self-report at the time of TB diagnosis or any time during TB treatment; injection drug use (IDU) is based on self-report in the 12 months prior to TB diagnosis.  
 \*TB risk categories are not mutually exclusive; an individual may be included in more than one category.

**Table 5 Top five countries of birth among foreign-born New Yorkers with TB/hepatitis B (HBV) and TB, NYC, 2000-2010**

TB/HBV (N=385)		TB (N=8,058)	
China	161 (42%)	China	1,136 (14%)
Philippines	18 (5%)	Ecuador	652 (8%)
Haiti	18 (5%)	Dominican Republic	542 (7%)
Dominican Republic	15 (4%)	Mexico	524 (7%)
India	15 (4%)	India	501 (6%)

Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012

## TB and Hepatitis B

As with hepatitis C, drugs used to treat TB may cause more severe liver inflammation and increase progression to serious liver disease among people with hepatitis B.<sup>21</sup> In addition, both TB and hepatitis B are common in foreign-born populations in NYC.<sup>21,22</sup>

Among New Yorkers with at least one diagnosis of TB between 2000 and 2010, 511 (4%) also had hepatitis B. Individuals who had TB and hepatitis B were primarily male (70%, data not shown), and half (50%) were Asian/Pacific Islander (Figure 11).

New Yorkers with TB and hepatitis B were more likely to be homeless (11% vs. 6%) than those without hepatitis B. A majority of people with TB, and people with both TB and hepatitis B, were foreign-born (Figure 12).

Among foreign-born New Yorkers with TB, China was the most common country of birth, and a greater proportion of individuals with TB and hepatitis B were born in China than those with only TB (42% vs. 14%) (Table 5). In addition, the Dominican Republic and India were in the top five most reported countries of birth for both groups.

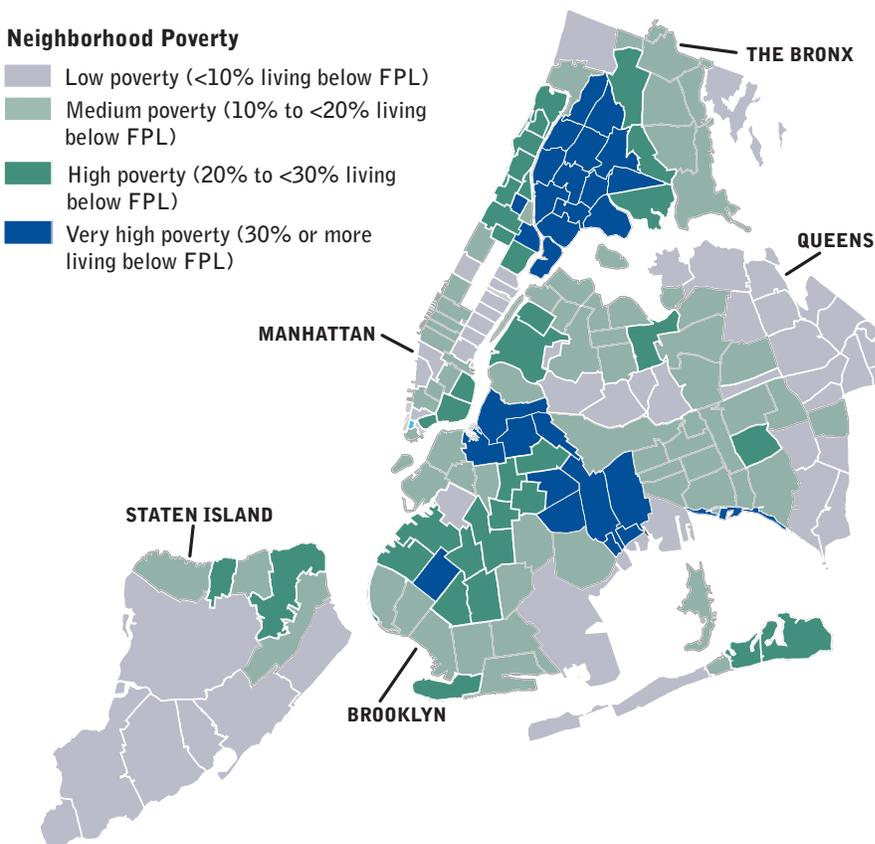
21 New York City Department of Health and Mental Hygiene. Bureau of Tuberculosis Control. *Three-year Summary: 2009, 2010, 2011*. New York, NY. 2012.

22 New York City Department of Health and Mental Hygiene. Bureau of Communicable Disease. *Hepatitis A, B and C Surveillance Report, 2008-2009*. New York, NY. 2010.

## Neighborhood Poverty and Disease

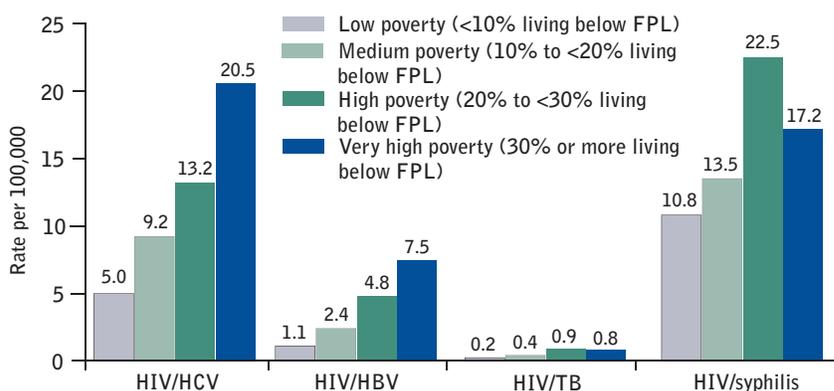
Poverty is often associated with worse health outcomes.<sup>23</sup> We examined combinations of diseases by neighborhood-level poverty, defined as the percent of the population within a zip code with household income below the federal poverty level (FPL) based on the 2007-2011 American Community Survey (ACS).<sup>24</sup> Most disease combinations we describe in this report were more common in zip codes where a greater proportion of the population lives below the FPL (Figures 13 and 14). In 2010, the rate of HIV/hepatitis C co-infection in the very high poverty neighborhoods of the city was about four times the rate in the low poverty neighborhoods. The rates of HIV/hepatitis B co-infection, and of persons with HIV and TB, also increased as the percentage of residents living in poverty increased. This pattern did not hold true for persons with HIV and syphilis.

**Figure 13 Neighborhood poverty by NYC zip code, 2007-2011**



Source: American Community Survey 2007-2011

**Figure 14 Rates per 100,000 New Yorkers of disease combinations by neighborhood poverty, NYC, 2010**



Source: NYC Department of Health and Mental Hygiene, Division of Disease Control, PCSI Syndemic Project, 2012; American Community Survey 2007-2011; FPL: Federal poverty level

23 Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic disparities in health in the United States: what the patterns tell us. *Am J Public Health*. 2010;100(Suppl 1):S186-S196.

24 Toprani A, Hadler JL. Selecting and applying a standard area-based socioeconomic status measure for public health data: analysis for New York City. New York City Department of Health and Mental Hygiene: *Epi Res Report*. May 2013; 1-12. (available by emailing query@health.nyc.gov).

## Discussion

Viral hepatitis, TB, HIV and STDs share common risk factors, making people who are at risk for one of these diseases at risk for others. Among the sexually transmitted diseases we examined, the overlap in populations was particularly large for syphilis and HIV. In addition to common risk factors, having two or more of these diseases can lead to health outcomes that are worse than what would be experienced by having just one of the diseases. We found that HIV was the most common disease of those that were examined among New Yorkers with either TB or viral hepatitis; infection with HIV is a risk factor for progression to TB disease, and for progression of liver disease in people with hepatitis B or C.

Our data have several limitations. First, surveillance data include only those people who were identified through testing and reported to the Health Department, and do not include people who remain untested and undiagnosed, or whose results were not reported. Thus, these data may be an underestimate of the burden of disease in New York City. Second, dates associated with reports of disease in Health Department surveillance databases reflect the date of testing, not the date of infection.

Particularly for chronic diseases (HIV, hepatitis B and hepatitis C), and TB which often have no symptoms or take a long time to become symptomatic, it is possible for a person to have been infected for many years before being diagnosed and appearing in surveillance data. Third, the data vary in quality and completeness across surveillance databases. The HIV and TB databases include data on risk factors and have relatively complete data on race and ethnicity, but the data in the STD and viral hepatitis databases are not as complete because of the large volume of cases and because Health Department follow-up is limited to only a subset of cases. Therefore, we were able only to use HIV and TB surveillance data for comparison groups because of the relative completeness of data.

The data also have several strengths. First, a match of these seven infectious diseases has never been done before in New York City. With these data we are able to understand which risk groups are most burdened by specific co-infections. Second, unlike other sources of data on co-infection, surveillance data include the entirety of the New York City population known to have these diseases, and thus are the most representative data source available. Third, the large scope of the project

will allow for many additional analyses. For example, the 11 year period of the project will allow us to look at temporality and trends, and the inclusion of the vital statistics data on deaths will allow for analyses of the role that infection with multiple diseases plays in mortality. Fourth, in the process of matching the data and conducting analyses, several programs within the Health Department worked together collaboratively to share data and make joint decisions, which has helped to develop additional collaborative projects guided by these findings.

This analysis – possible only through data sharing across disease programs – identified co-infections that can be addressed through integrated services. In Health Department STD clinics, both STD and HIV testing are available, and hepatitis A and B vaccines are provided to individuals at high risk. Health Department TB clinics offer both TB and HIV testing, and test patients undergoing TB treatment for hepatitis A, B and C. Health Department training centers for clinical and non-clinical providers, historically focused on prevention of HIV and STDs, are also integrating across diseases and offering training courses that address viral hepatitis and TB prevention. To facilitate integrated services outside of our clinics, we are offering technical assistance to providers in areas of the city with high rates of

co-infection based on the findings of this project. Many medical practices now have electronic health records in place, which allow providers to

more easily identify patients that may need to be tested for more than one disease. Knowledge of the relationships between infectious diseases gained through this project

is crucial to reaching the most impacted communities with interventions to prevent, test for and treat multiple diseases.

### Technical Notes

**Missing data:** All analyses excluded missing values. Missing data did not comprise more than 3% of all persons reported with a disease.

**Race/ethnicity:** Race categories of other, multi-race, American Indian/Alaska Native, and unknown comprised 1% or fewer persons in the dataset and were not included in analysis.

**Statistical significance:** All comparisons highlighted are statistically significant based on bivariate analysis and have p-values of <0.0001.

**Comparison groups:** In analysis of specific disease combinations, persons may have other diseases in addition to the two diseases being compared. For example, when comparing people with HIV to people with HIV/hepatitis C co-infection, people with TB are not excluded from either group.

**Acute vs. chronic infections:** TB, chlamydia, gonorrhea and syphilis are treatable, acute (short-term) diseases, and one person could have multiple cases of the disease over time. For this report, people were characterized as having had at least one case of an acute disease or none, and information from the most recent report was used for those who had two or more reports. Hepatitis B, hepatitis C and HIV/AIDS are chronic (long-term) diseases with only one case per person.

### For More Information

More detailed surveillance data on each of the diseases presented in this report are available at the Department of Health website. Search by topic at [nyc.gov/health](http://nyc.gov/health) or see Health Data Publications available at <http://www.nyc.gov/html/doh/html/data/data-publications.shtml>.

- Hepatitis A, B and C Surveillance Data
- TB Reports
- Sexually Transmitted Disease Control Quarterly Reports
- HIV/AIDS Surveillance Statistics

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