



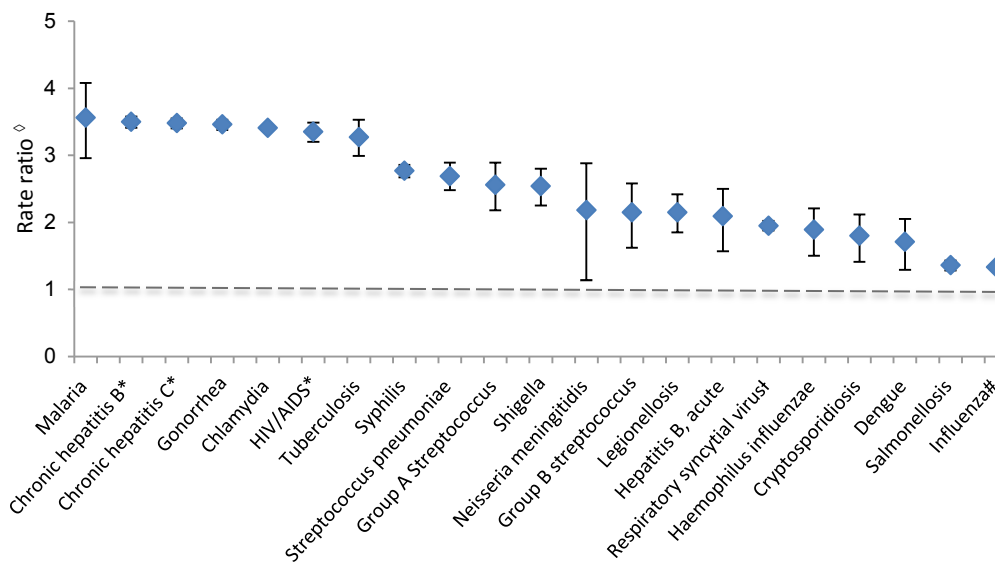
Neighborhood Poverty and Infectious Diseases: Health Disparities in New York City

For many health conditions, income and other socioeconomic factors are associated with risk of illness or death.^{1,2} Area-based poverty measures may be useful for defining populations at increased risk for disease and documenting disparities in disease rates; furthermore, identifying which diseases are most concentrated in high poverty areas may inform outreach, educational efforts, and other prevention measures. This data brief describes the association between disease rates and area-based poverty for 38 infectious diseases reported to the New York City (NYC) Health Department between 2006 and 2013.

Infectious diseases by neighborhood poverty in New York City

- New Yorkers residing in very high poverty census tracts were more likely to be diagnosed with 21 of the 38 infectious diseases examined, compared with persons residing in low poverty census tracts.
- Diseases most strongly associated with very high poverty included malaria, chronic hepatitis B and C, gonorrhea, chlamydia, HIV/AIDS, tuberculosis (TB), and syphilis (all stages). This association can be described using a rate ratio, which compares the rate in the very high versus low poverty levels; for example, New Yorkers residing in a very high poverty neighborhood had approximately 3.5 times greater risk of being newly reported with a chronic hepatitis C diagnosis than those residing in a low poverty neighborhood.

Twenty-one infectious diseases were associated with residence in very high poverty neighborhoods[^] in New York City, 2006–2013



[^] Neighborhood poverty (based on census tract) defined as percent of residents with income below the Federal Poverty Level (FPL), per American Community Survey (very high is $\geq 30\%$ below FPL; low is $< 10\%$ below FPL).

[◇] A rate ratio greater than one (above the dashed line) indicates the disease rate is higher among residents of very high poverty neighborhoods than among residents of low poverty neighborhoods. Bars represent 95% confidence intervals, which are an estimate of precision. A smaller bar indicates a more precise estimate. All rate ratios shown here are statistically significantly greater than 1.0. Rates were age-adjusted to the 2000 US standard population.

*Data for HIV/AIDS and chronic hepatitis B and C reflect cases newly reported during the study period, not incidence or prevalence rates. Study period for HIV/AIDS was 2007-2013.

† Study period for respiratory syncytial virus was 2008-2013.

Influenza only reflects laboratory-confirmed influenza, which is an underestimate of influenza incidence.

Sources: NYC DOHMH HIV/AIDS, Communicable Disease, STD, and TB surveillance data 2006-2013, and American Community Survey 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

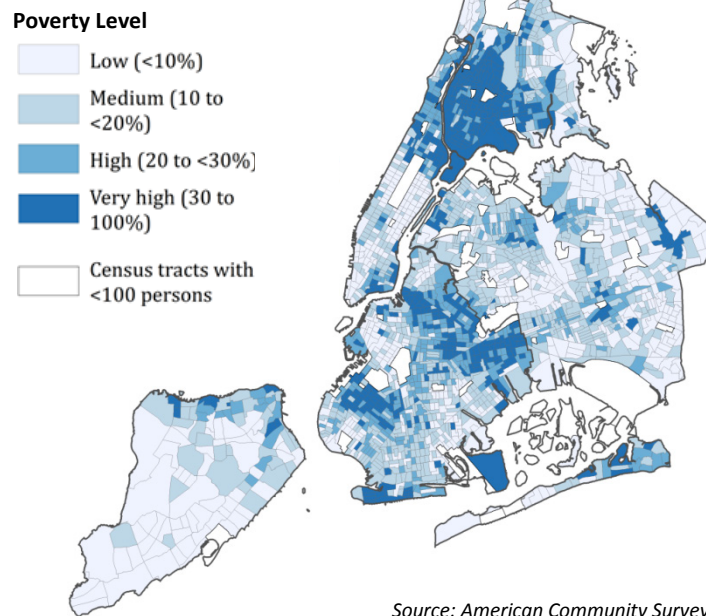
Neighborhood poverty:

Neighborhoods in this analysis were defined by census tract; NYC contains 2,166 census tracts. Census tracts were grouped together into four poverty levels for analysis: $< 10\%$ of residents below the Federal Poverty Level (FPL) (**low poverty**), 10 to $< 20\%$ (**medium**), 20 to $< 30\%$ (**high**), and $\geq 30\%$ (**very high poverty**). Numbers of reported cases of each disease were aggregated to census tracts and to the poverty level corresponding to each census tract. All analyses were neighborhood-level, not individual person-level. For example, a person diagnosed with tuberculosis who lived in a very high poverty census tract would have been classified as very high poverty, even if that individual's income was above the FPL.

Poverty occurs alongside other risk factors for infectious diseases

- In NYC, very high poverty census tracts are distributed throughout the five boroughs, with clustering in certain areas such as the Bronx.
- Although multiple diseases were associated with poverty, not all diseases associated with high poverty had high rates in the same census tracts; for example, there is variation in disease distribution for chronic hepatitis C and chlamydia across census tracts in high poverty neighborhoods (see Epi Data Tables for maps).
- The association between **chronic hepatitis C** and poverty may be related to injection drug use. Injection drug use is a common risk factor for hepatitis C and is associated with living in poverty.^{3,4}

Geographic distribution of poverty level by census tract in New York City, 2009–2013



Source: American Community Survey 2009–2013

- **Chronic hepatitis B** primarily occurs among foreign-born populations in NYC, particularly immigrants from China;^{5,6} these populations also tend to reside in neighborhoods with high poverty levels.
- Similar to chronic hepatitis B, the association between **malaria** and high poverty neighborhoods likely reflects immigration patterns. Malaria cases were all related to travel outside the US (generally to visit family or friends) or to recent immigration to NYC.⁷
- Higher **gonorrhea** and **chlamydia** rates among persons living in higher poverty neighborhoods may be related to a higher prevalence of STD in those neighborhoods' sexual networks, such that there is a higher risk of selecting an infected partner. Other contributing factors could include barriers to accessing and using risk reduction information and sexual health services.

Methodology: Surveillance data of newly reported disease events diagnosed during 2006–2013 were provided by the NYC Department of Health and Mental Hygiene (DOHMH) Bureaus of HIV/AIDS Prevention and Control, Communicable Disease, STD Prevention and Control, and Tuberculosis (TB) Control. All reported events were geocoded to determine census tract of residence at time of report; only cases residing in NYC were included. Age-adjusted average annual rates per 100,000 population were calculated for each disease in each of four census tract-based poverty levels, based on the percent of residents with incomes below the federal poverty level. Persons identified as homeless were assigned to the highest poverty level. Incarcerated individuals were excluded from analysis. Rate ratios (RR) were calculated to compare disease rates in the very high and low poverty neighborhoods.

Diseases analyzed: HIV/AIDS, chronic hepatitis B and C, chlamydia, gonorrhea, syphilis, tuberculosis (TB), and 31 other reportable communicable diseases, including enteric, vectorborne, and respiratory infections (see Epi Data Tables for complete list of diseases). Data were integrated across infectious disease programs by DOHMH's Division of Disease Control through the Program Collaboration and Service Integration initiative.⁸

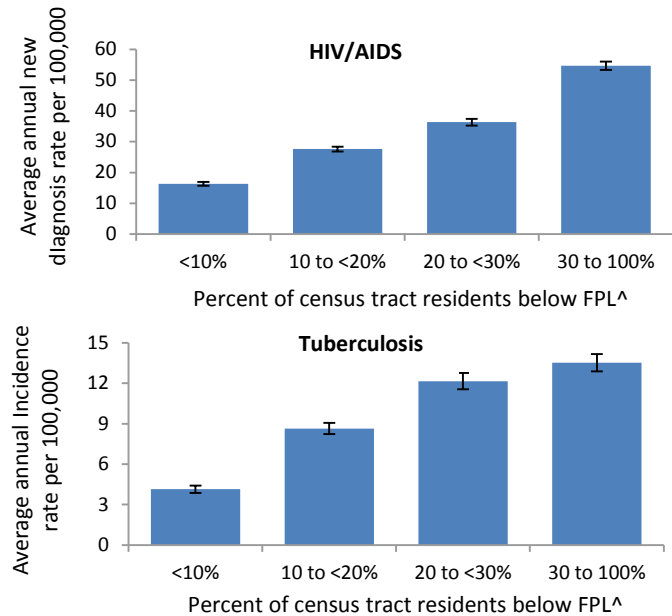
Data Sources: 2007–2013 HIV/AIDS surveillance data, DOHMH Bureau of HIV/AIDS Prevention and Control; 2006–2013 surveillance data for 33 diseases, Bureau of Communicable Disease; 2006–2013 chlamydia, gonorrhea, and syphilis surveillance data, Bureau of STD Prevention and Control; 2006–2013 TB data, Bureau of TB Control.

Rates were calculated using DOHMH-developed intercensal census tract-based population estimates by poverty level. Census tract-based poverty levels were created using ACS 5-year estimates, following standard DOHMH guidelines: ACS estimates for 2006–2010, 2007–2011, 2008–2012, and 2009–2013 were used for surveillance data years 2006–2008, 2009, 2010, and 2011–2013, respectively.⁹ Variations in data between this report and other DOHMH publications may be due to reporting delays, the availability of census data, corrections of errors, and refinements in data processing.

Public Health Disparities Geocoding Project (PHDGP) The National Institutes of Health funded PHDGP to better describe, monitor, and understand how socioeconomic inequalities impact health.¹ DOHMH adapted the PHDGP guidelines to NYC and recommends that all analyses of routinely collected surveillance data with geographic information include a neighborhood poverty variable.⁹

- The recent high rates of **HIV/AIDS** diagnoses among persons living in higher poverty census tracts are likely related to a combination of population and socioeconomic factors (e.g., age, race/ethnicity, education, housing, and employment) that influence HIV/AIDS prevalence, sexual networks, and corresponding risk.¹⁰
- Though most **TB** cases occur among persons who are foreign-born, the association between poverty and TB is strongest among US-born cases in NYC.¹¹ Risk factors such as homelessness and drug use may contribute to this relationship; these risk factors are more prevalent among US-born patients and are associated with poverty in NYC. Foreign-born populations residing in higher poverty neighborhoods also contribute to the association between TB and poverty, although the association is less pronounced.
- Poverty influences not only the risk of exposure to infectious diseases, but also susceptibility to illness following exposure. Risks vary across all poverty levels; in addition to the 21 diseases associated with high poverty, an additional 10 diseases were associated with residing in low poverty areas (see Epi Data Tables).

Average annual rates of HIV/AIDS and tuberculosis increased with increasing neighborhood poverty[^] in New York City, 2006–2013



[^] Neighborhood poverty (based on census tract) defined as percent of residents with income below the Federal Poverty Level (FPL), per American Community Survey (very high is $\geq 30\%$ below FPL; low is $<10\%$ below FPL).

Notes: Bars represent 95% confidence intervals, which are an estimate of precision. A smaller bar indicates a more precise estimate. Rates were age-adjusted to the 2000 US standard population.

Sources: HIV/AIDS surveillance data 2007–2013, TB surveillance data 2006–2013, and American Community Survey 5-year estimates, 2006–2010, 2007–2011, 2008–2012, and 2009–2013.

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Epi Data Tables

New York City Department of Health and Mental Hygiene

March 2016, No. 68

Neighborhood Poverty and Infectious Diseases: Health Disparities in New York City

Data Tables

- Table 1.** Diseases included in analysis of neighborhood poverty, by New York City Department of Health and Mental Hygiene surveillance programs, 2006-2013.
- Table 2.** Association between diseases and neighborhood poverty: number of disease events and rate ratios with 95% confidence intervals, New York City, 2006-2013.
- Figures 1-6.** Average annual rates of malaria, chronic hepatitis B and C, gonorrhea, chlamydia, and syphilis by neighborhood poverty level, New York City, 2006-2013.
- Maps 1-8.** Average annual rates of malaria, chronic hepatitis B and C, gonorrhea, chlamydia, HIV/AIDS, tuberculosis, and syphilis by census tract, New York City, 2006-2013.

Data Sources

2007-2013 HIV/AIDS surveillance data, DOHMH Bureau of HIV/AIDS Prevention and Control; 2006-2013 surveillance data for 33 diseases, Bureau of Communicable Disease (BCD) (see table 1 for list); 2006-2013 chlamydia, gonorrhea, and syphilis surveillance data, Bureau of STD Prevention and Control; 2006-2013 tuberculosis (TB) data, Bureau of TB Control. Rates were calculated using DOHMH-developed intercensal census tract-based population estimates by poverty level. Census tract-based poverty levels were created using American Community Survey (ACS) five-year estimates, following standard DOHMH guidelines: ACS estimates for 2006-2010, 2007-2011, 2008-2012, and 2009-2013 were used for surveillance data years 2006-2008, 2009, 2010, and 2011-2013, respectively. Variations in data between this report and other DOHMH publications may be due to reporting delays, the availability of census data, corrections of errors, and refinements in data processing.

Table 1. Diseases included in analysis of neighborhood poverty, by New York City Department of Health and Mental Hygiene (DOHMH) surveillance programs, 2006-2013

DOHMH Program	Disease
Communicable Disease	Acute hepatitis B
	Amebiasis
	Anaplasmosis, human granulocytic
	Babesiosis
	Campylobacteriosis
	Chronic hepatitis B
	Chronic hepatitis C
	Cryptosporidiosis
	<i>Cyclospora</i>
	Dengue fever
	Ehrlichiosis, human monocytic
	Giardiasis
	Group A <i>Streptococcus</i>
	Group B <i>Streptococcus</i>
	<i>Haemophilus influenzae</i>
	Hepatitis A
	Influenza (laboratory-confirmed)
	Legionellosis
	Listeriosis
	Lyme disease
	Malaria
	<i>Neisseria meningitidis</i>
	Paratyphoid fever
	Respiratory syncytial virus
	<i>Salmonella</i>
	Shiga toxin-producing <i>E. coli</i>
	Shigellosis
	<i>Streptococcus pneumoniae</i>
	Transmissible spongiform encephalopathy
	Typhoid fever
	Vibrio species (non-cholera)
	West Nile neuroinvasive disease
	Yersiniosis
HIV/AIDS Prevention and Control	HIV/AIDS
STD Prevention and Control	Chlamydia
	Gonorrhea
	Syphilis
Tuberculosis Control	Tuberculosis

Table 2. Association between diseases and neighborhood poverty:^a number of disease events and rate ratios (RR) with 95% confidence intervals (CI), New York City, 2006–2013

Sources: NYC DOHMH HIV/AIDS, Communicable Disease, STD, and TB surveillance data 2006–2013, and American Community Survey 5-year estimates, 2006–2010, 2007–2011, 2008–2012, and 2009–2013

Disease	Number of disease events included in analysis	Rate ratio comparing very high with low poverty neighborhoods (95% CI)	Is disease associated with residing in very high or low poverty neighborhood?
Malaria	1,573	3.56 (3.04, 4.16)	
Chronic hepatitis B*	65,632	3.50 (3.42, 3.59)	
Chronic hepatitis C*	64,487	3.48 (3.41, 3.56)	
Gonorrhea	80,823	3.46 (3.39, 3.54)	
Chlamydia	372,274	3.41 (3.38, 3.45)	
HIV/AIDS*	18,978	3.35 (3.21, 3.50)	
Tuberculosis	5,970	3.23 (2.98, 3.51)	
Syphilis (all stages)	30,485	2.77 (2.68, 2.87)	
<i>Streptococcus pneumoniae</i>	5,366	2.69 (2.49, 2.90)	
Group A <i>Streptococcus</i>	1,573	2.56 (2.23, 2.94)	
Shigellosis	3,050	2.54 (2.28, 2.83)	Very high
<i>Neisseria meningitidis</i>	208	2.18 (1.48, 3.22)	
Group B <i>Streptococcus</i>	4,270	2.15 (1.72, 2.68)	
Legionellosis	1,586	2.15 (1.88, 2.45)	
Acute hepatitis B	666	2.09 (1.68, 2.61)	
Respiratory syncytial virus [†]	24,514	1.95 (1.88, 2.02)	
<i>Haemophilus influenzae</i>	790	1.89 (1.57, 2.28)	
Cryptosporidiosis	828	1.80 (1.48, 2.19)	
Dengue fever	635	1.71 (1.37, 2.13)	
<i>Salmonella</i>	9,208	1.36 (1.29, 1.44)	
Influenza (laboratory-confirmed) [#]	35,355	1.33 (1.29, 1.36)	
Typhoid fever	379	1.27 (0.90, 1.79)	
Listeriosis	275	1.10 (0.79, 1.54)	
Amebiasis	3,420	1.06 (0.96, 1.17)	
Campylobacteriosis	9,277	1.05 (0.99, 1.11)	No association
Yersiniosis	141	0.94 (0.58, 1.55)	
Hepatitis A	729	0.91 (0.73, 1.14)	
Paratyphoid fever ^{&}	64	0.83 (0.35, 1.97)	
Giardiasis	6,793	0.93 (0.87, 0.99)	
Shiga toxin-producing <i>E. coli</i>	535	0.59 (0.46, 0.76)	
Lyme disease	9,685	0.37 (0.34, 0.39)	
<i>Cyclospora</i>	139	0.29 (0.15, 0.53)	
Transmissible spongiform encephalopathy	40	0.26 (0.08, 0.87)	Low
<i>Vibrio</i> species (non-cholera)	127	0.24 (0.12, 0.48)	
Babesiosis	322	0.23 (0.15, 0.36)	
West Nile neuroinvasive disease	100	0.20 (0.08, 0.52)	
Ehrlichiosis, human monocytic	79	0.13 (0.05, 0.33)	
Anaplasmosis, human granulocytic	163	0.08 (0.03, 0.20)	

Notes: Numbers presented are events among non-incarcerated NYC residents with a geocodable address and do not represent all diagnosed and reported events during the time period. Percent of disease events geocoded by disease ranged from 80 to 99%.

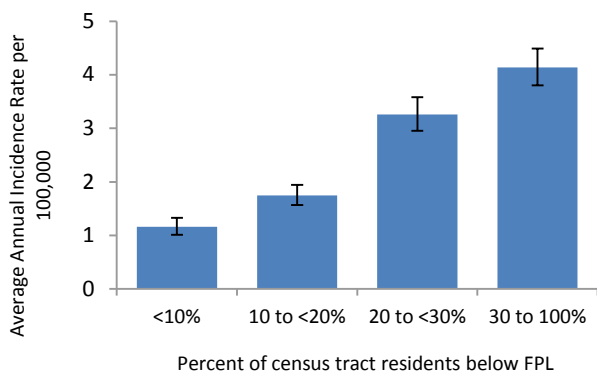
^aNeighborhood poverty (based on census tract) defined as percent of residents with income below the Federal Poverty Level (FPL), per American Community Survey (very high is $\geq 30\%$ below FPL; low is $< 10\%$ below FPL).

*Data for HIV/AIDS and chronic hepatitis B and C reflect cases newly reported during the study period, not incidence or prevalence rates. Study period for HIV/AIDS was 2007–2013. [†]Study period for respiratory syncytial virus was 2008–2013. [#]Influenza only reflects laboratory-confirmed influenza, which is an underestimate of influenza incidence. [&]Study period for paratyphoid fever was 2009–2013.

Figures 1-6. Average annual rates of malaria, chronic hepatitis B and C, gonorrhea, chlamydia, and syphilis by neighborhood poverty level,[^] New York City, 2006-2013.

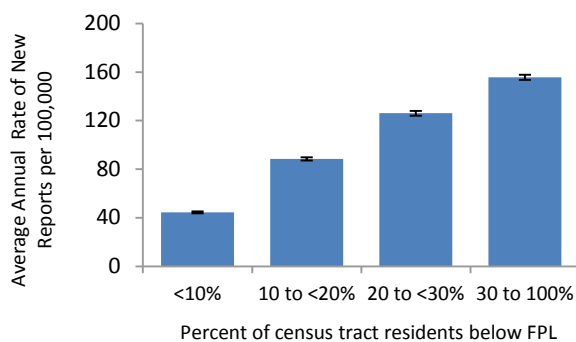
Sources: NYC DOHMH HIV/AIDS, Communicable Disease, STD, and TB surveillance data 2006-2013 as noted below each figure, and American Community Survey 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 1. Average annual incidence rate of malaria by poverty level, New York City, 2006-2013



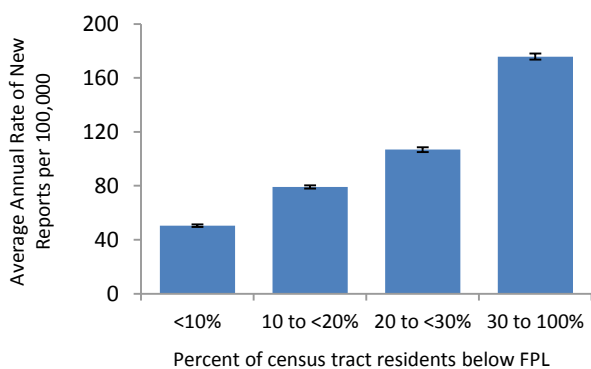
Sources: BCD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 2. Average annual rate of new reports of chronic hepatitis B by poverty level, New York City, 2006-2013



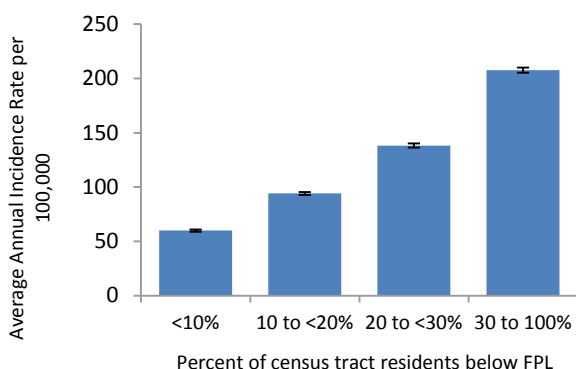
Sources: BCD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 3. Average annual rate of new reports of chronic hepatitis C by poverty level, New York City, 2006-2013



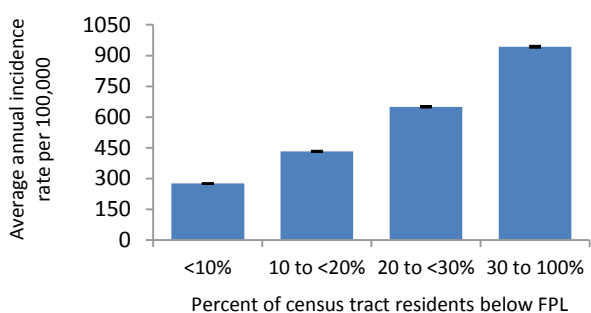
Sources: BCD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 4. Average annual rate of new reports of gonorrhea by poverty level, New York City, 2006-2013



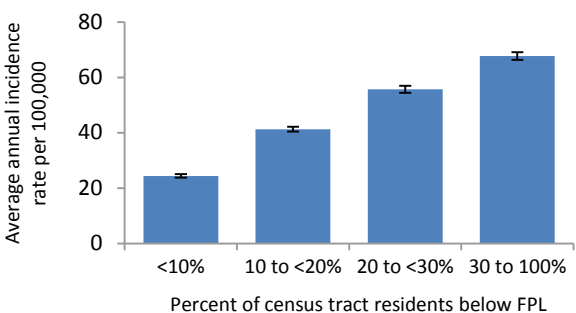
Sources: STD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 5. Average annual rate of new reports of chlamydia by poverty level, New York City, 2006-2013



Sources: STD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

Figure 6. Average annual rate of new reports of syphilis by poverty level, New York City, 2006-2013



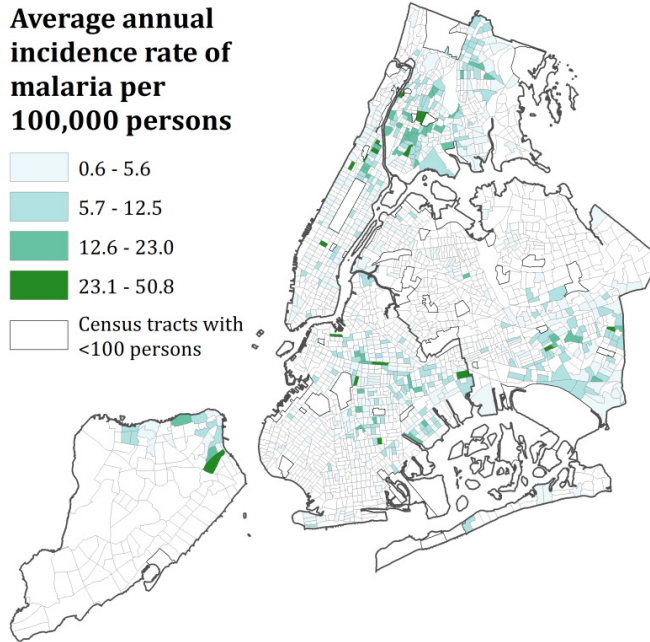
Sources: STD surveillance data and ACS 5-year estimates, 2006-2010, 2007-2011, 2008-2012, and 2009-2013

[^]Neighborhood poverty (based on census tract) defined as percent of residents with income below the Federal Poverty Level (FPL), per ACS. Notes: Bars represent 95% confidence intervals, which are an estimate of precision. A smaller bar indicates a more precise estimate. Rates were age-adjusted to the 2000 US standard population.

Maps 1-8. Average annual rates of malaria, chronic hepatitis B and C, gonorrhea, chlamydia, HIV/AIDS, tuberculosis, and syphilis by census tract, New York City, 2006-2013.

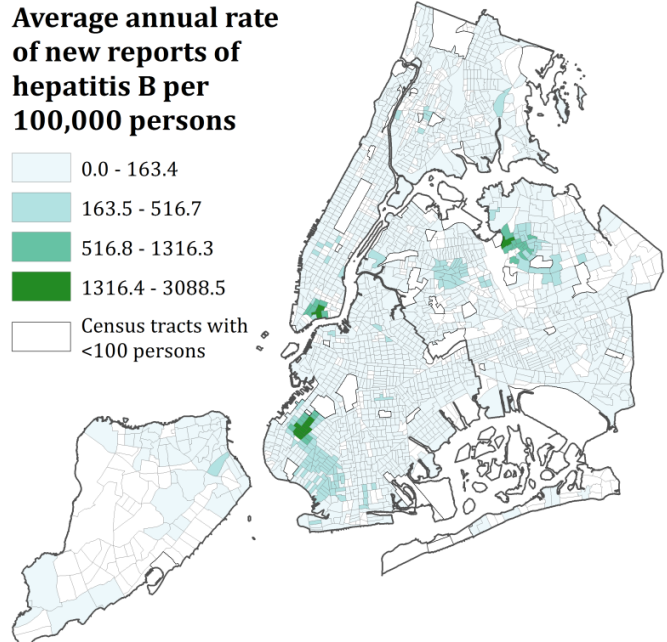
Sources: NYC DOHMH HIV/AIDS, Communicable Disease, STD, HIV/AIDS and TB surveillance data 2006-2013 as noted below each figure, and Census 2010
 Methodology: For maps, age-adjusted average annual rates per 100,000 population were calculated in each NYC census tract for each of the eight diseases most strongly associated with residing in very high poverty neighborhoods. Population estimates for rate calculations were from the 2010 Census, and the US 2000 standard population was used for age adjustment. Homeless individuals who were not geocoded to a census tract and incarcerated individuals are not included in rates shown on maps.

Map1. Average annual incidence rate of malaria by census tract in New York City, 2006-2013



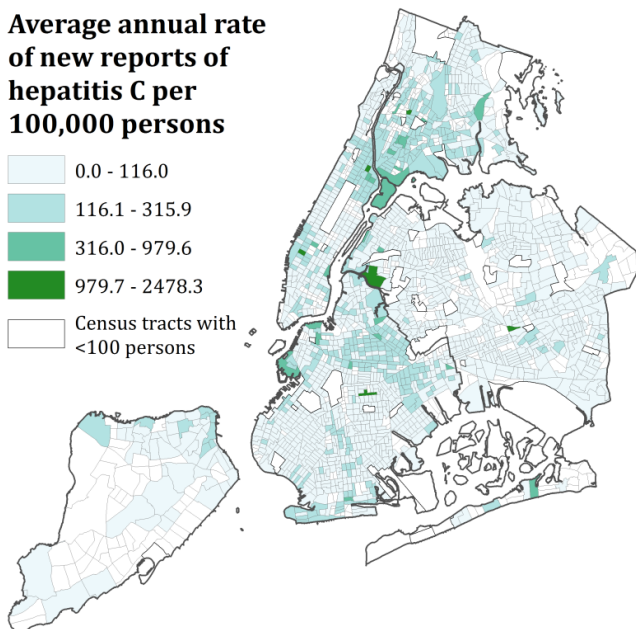
Sources: BCD surveillance data and Census 2010

Map2. Average annual rate of new reports of chronic hepatitis B by census tract in New York City, 2006-2013



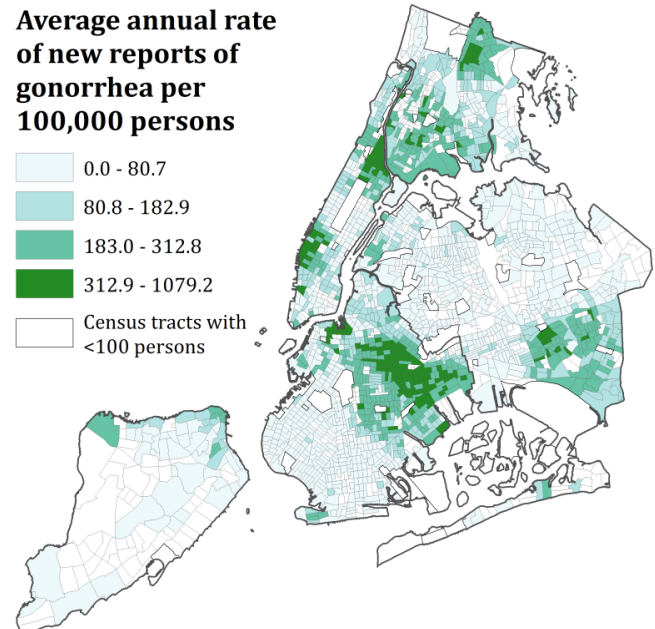
Sources: BCD surveillance data and Census 2010

Map 3. Average annual rate of new reports of chronic hepatitis C by census tract in New York City, 2006-2013



Sources: BCD surveillance data and Census 2010

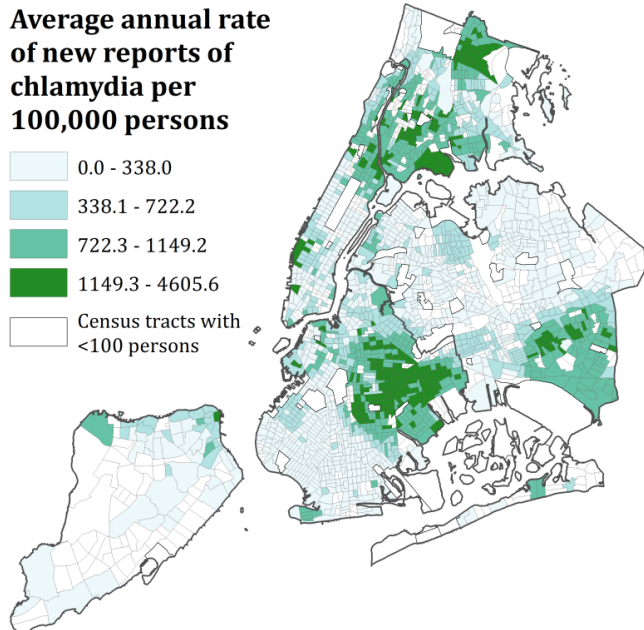
Map 4. Average annual rate of new reports of gonorrhea by census tract in New York City, 2006-2013



Sources: STD surveillance data and Census 2010

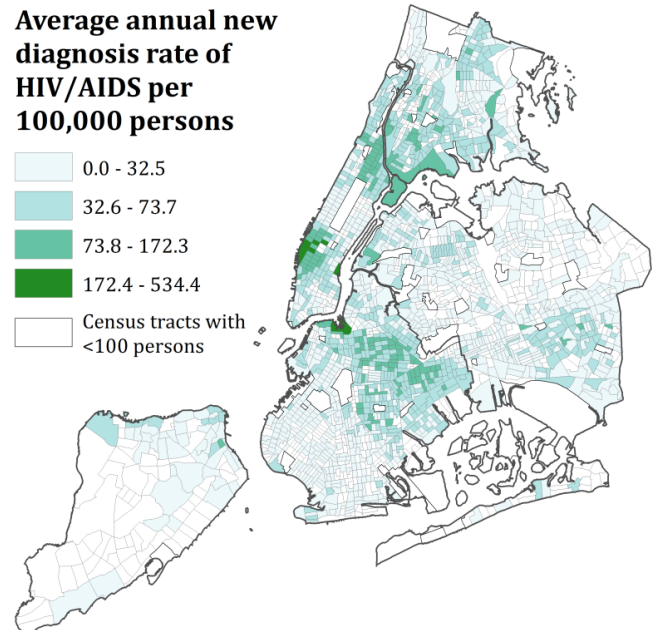
Maps 1-8 (continued). Average annual rates of malaria, chronic hepatitis B and C, gonorrhea, chlamydia, HIV/AIDS, tuberculosis, and syphilis by census tract, New York City, 2006-2013.

Map 5. Average annual rate of new reports of chlamydia by census tract in New York City, 2006-2013



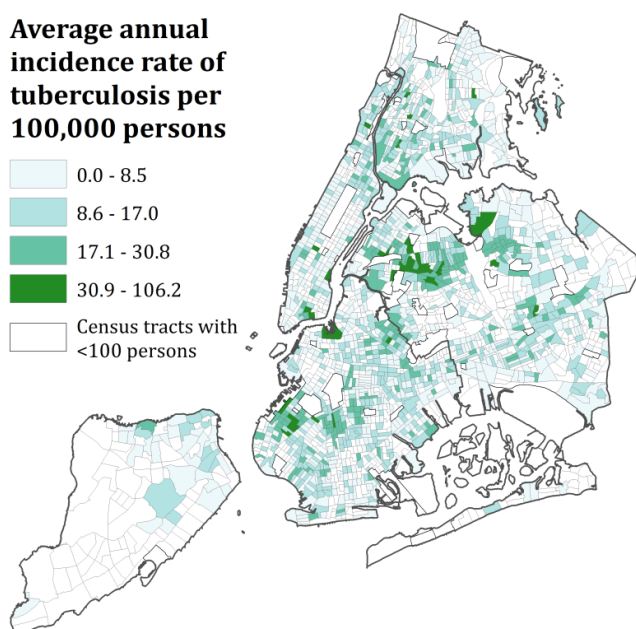
Sources: STD surveillance data and Census 2010

Map 6. Average annual new diagnosis rate of HIV/AIDS by census tract in New York City, 2007-2013



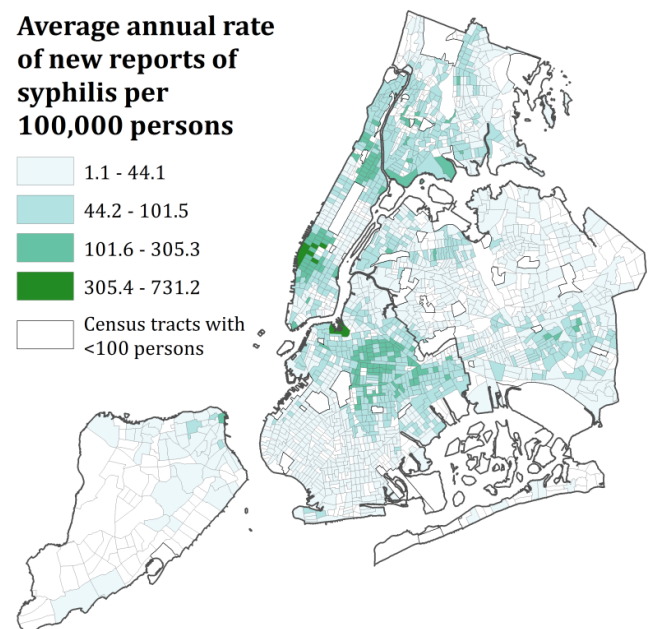
Sources: HIV/AIDS surveillance data and Census 2010

Map 7. Average annual incidence rate of tuberculosis by census tract in New York City, 2006-2013



Sources: TB surveillance data and Census 2010

Map 8. Average annual rate of new reports of syphilis by census tract in New York City, 2006-2013



Sources: STD surveillance data and Census 2010