Supplementary material

eTable 1. Neighborhood measure definitions and data sources.

Measure	Definition	Data Source
Poverty rate	% population earning below the poverty income threshold	American Community Survey (ACS), 2018 5-year
Per capita income	Per capita income in the past 12 months	ACS, 2018 5-year
% White	% population with race identified as white alone	ACS, 2018 5-year
% Black	% population with race identified as Black or African American alone	ACS, 2018 5-year
% Hispanic	% population with ethnicity identified as of Hispanic or Latinx origin	ACS, 2018 5-year
% No high school diploma	% population 25 years and over, less than a high school diploma	ACS, 2018 5-year
% Children	% population under 18	ACS, 2018 5-year
% Vacant housing	% of vacant housing units	ACS, 2018 5-year
% Long-term occupancy	% of population who moved into their current housing more than 20 years ago	ACS, 2018 5-year
Foreclosure rate	Estimated % of mortgages to start foreclosure process or be seriously delinquent during the 2008 Recession.	Neighborhood Stabilization Program (NSP2), U.S. Department of Housing and Urban Development (HUD), Office of Policy Development and Research, 2009
Traffic volume	Logged total annual average daily traffic counts per road segment. The final result is then scaled from 0 to 100, with higher numbers correspond to greater traffic.	Illinois Department of Transportation (IDOT), 2019
Property crime per 1000	Property crimes per 1000 residents. Based on the Chicago Police Department, property crimes include arson, burglary, motor vehicle theft and theft.	Chicago Data Portal, 2019.
Violent crime per 1000	Violent crimes per 1000 residents. Based on the Chicago Police Department, violent crimes include assault, battery, criminal sexual assault, homicide, robbery, human trafficking.	Chicago Data Portal, 2019.

eTable 2: Risk activity spaces: within and outside Cook and Collar counties.

	Buy drugs		Inject drugs		Meet sex partners	
	Within boundary	Outside boundary	Within boundary	Outside boundary	Within boundary	Outside boundary
suburban	235	1	162	2	83	4
transient	359	2	233	4	112	20
urban	422	0	298	0	133	6

Note. Boundary refers to the geographic boundary of Cook and Collar counties.

eTable 3. Table 2 in the manuscript with numbers of missing reported.

Variable	All, N = 258	Suburban, N = 72	Transient, N = 77	Urban, N = 109	*p*-value
Race/Ethnicity					.025
Hispanic	65 (25%)	23 (32%)	15 (19%)	27 (25%)	
Non-Hispanic White	153 (59%)	45 (62%)	50 (65%)	58 (53%)	
Other	40 (16%)	4 (5.6%)	12 (16%)	24 (22%)	
Gender					.8
Male	185 (72%)	49 (68%)	56 (73%)	80 (73%)	
Female	72 (28%)	23 (32%)	21 (27%)	28 (26%)	
Transgender	1 (0.4%)	0 (0%)	0 (0%)	1 (0.9%)	
Age					.3
17-25	48 (19%)	17 (24%)	14 (18%)	17 (16%)	
26-29	114 (44%)	36 (50%)	33 (43%)	45 (41%)	
30-34	49 (19%)	10 (14%)	18 (23%)	21 (19%)	
35 +	47 (18%)	9 (12%)	12 (16%)	26 (24%)	
Homeless	167 (65%)	21 (29%)	66 (86%)	80 (73%)	<.001
Homeless (# of days)	90 (30, 178)	40 (20, 100)	78 (30, 90)	120 (60, 180)	<.001
Unknown	91	51	11	29	

Note. Only Homeless (# of days) have missing data. We focus on Homeless status instead in the paper. Both show consistent trend that transient and urban PWID experienced more homelessness than suburban PWID.

eTable 4. Table 3 in the manuscript with numbers of missing reported.

Variable	All, N = 258	Suburban, N = 72	transient, N = 77	Urban, N = 109	*p*-value
Used crack	215 (84%)	58 (82%)	69 (90%)	88 (81%)	.2
Unknown	1	1	0	0	
Injected crack	101 (39%)	20 (28%)	36 (47%)	45 (41%)	.05
Injected speedball	112 (43%)	24 (33%)	35 (45%)	53 (49%)	.12
Used methamphetamine	72 (28%)	14 (20%)	25 (32%)	33 (30%)	.2
Unknown	1	1	0	0	
Injected methamphetamine	59 (23%)	8 (11%)	25 (32%)	26 (24%)	.008
Receptive syringe sharing	106 (42%)	30 (42%)	36 (47%)	40 (38%)	.5
Unknown	7	1	1	5	
Sharing cookers	179 (72%)	50 (70%)	63 (84%)	66 (63%)	.011
Unknown	8	1	2	5	
Backloading	95 (38%)	19 (27%)	40 (53%)	36 (35%)	.004
Unknown	7	1	1	5	
Experienced overdose past 6 months	93 (36%)	21 (29%)	36 (47%)	36 (33%)	.057
Revived with Naloxone past 6 months	81 (31%)	17 (24%)	31 (40%)	33 (30%)	.086
Months since last overdose	7 (2, 25)	12 (3, 28)	4 (2, 19)	7 (2, 26)	.06
Unknown	61	12	15	34	
Months since last Naloxone	8 (2, 27)	12 (5, 27)	5 (2, 25)	6 (2, 27)	.14
Unknown	80	19	18	43	
HCV positive	77 (32%)	9 (13%)	22 (29%)	46 (45%)	<.001
Unknown	14	5	2	7	
HIV positive	3 (1.2%)	0 (0%)	2 (2.7%)	1 (1.0%)	.5
Unknown	13	4	2	7	

Note. Months since last overdose and months since last Naloxone have relatively more missing data. We focus on HCV and HIV positive results in the paper.

eTable 5. Table 4 in the manuscript with missing value reported, along with sexual and support network comparison among three residential groups.

Variable	All, N = 258	Suburban, N = 72	Transient, N = 77	Urban, N = 109	*p*-value
Injection Network					
Network degree	3.00 (2.00, 5.00)	3.00 (2.00, 4.00)	4.00 (3.00, 6.00)	3.00 (2.00, 5.00)	.002
Unknown	1	0	0	1	
Mean strength of ties	3.00 (2.75, 3.60)	3.00 (2.84, 3.62)	3.00 (2.71, 3.33)	3.00 (2.66, 4.00)	.5
Unknown	1	0	0	1	
Age standard deviation	5.9 (3.5, 8.7)	3.6 (1.5, 6.5)	7.1 (4.6, 9.3)	6.1 (4.3, 9.1)	<.001
Unknown	36	9	6	21	
Average age of alters	32 (29, 36)	31 (27, 35)	33(30, 36)	33 (30, 37)	.004
Unknown	1	0	0	1	
Max age of alters	38 (32, 47)	34 (29, 40)	40 (35, 48)	40 (32, 50)	< .001
Unknown	1	0	0	1	
% alters living in Cook	100 (50, 100)	50 (0, 100)	100 (60, 100)	100 (97, 100)	<.001
Unknown	1	0	0	1	
Network effective size	2.06 (1.25, 3.05)	1.75 (1.32, 2.48)	2.71 (1.84, 4.00)	2.00 (1.00, 2.93)	.002
Unknown	1	0	0	1	
Network tie density	0.93 (0.73, 1.00)	1.00 (0.83, 1.00)	0.86 (0.69, 1.00)	0.97 (0.80, 1.00)	.014
Unknown	1	0	0	1	
Sexual Network					
Network degree	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	1.00 (1.00, 2.00)	1.00 (1.00, 2.00)	.015
Unknown	53	14	10	29	
Mean strength of ties	3.67 (3.00, 4.00)	4.00 (3.00, 4.00)	3.33 (2.83, 4.00)	3.33 (2.50, 4.00)	.070
Unknown	53	14	10	29	
Age standard deviation	4.2 (2.1, 7.6)	2.8 (1.9, 5.2)	4.7 (3.6, 7.6)	3.5 (2.1, 7.9)	.4
Unknown	186	60	49	77	
Average age of alters	29 (25, 34)	26 (24, 30)	29 (25, 33)	31 (27, 38)	<.001
Unknown	57	15	11	31	

Max age of alters	30 (26, 36)	28 (24, 32)	30 (26, 36)	32 (28, 44)	<.001
Unknown	57	15	11	31	
% alters living in Cook	100 (0, 100)	0 (0, 100)	100 (0, 100)	100 (63, 100)	<.001
Unknown	53	14	10	29	
Network effective size	1.00 (1.00, 1.70)	1.00 (1.00, 1.00)	1.00 (1.00, 2.00)	1.00 (1.00, 2.00)	.015
Unknown	53	14	10	29	
Network tie density	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (0.83, 1.00)	1.00 (0.88, 1.00)	.10
Unknown	53	14	10	29	
Support Network					
Network degree	2.00 (1.00, 3.00)	2.00 (1.00, 3.00)	2.00 (1.00, 3.00)	2.00 (1.00, 2.00)	.2
Unknown	12	0	1	11	
Mean strength of ties	3.50 (3.00, 4.00)	3.67 (3.46, 4.00)	3.33 (2.67, 4.00)	3.58 (3.00, 4.00)	.012
Unknown	12	0	1	11	
Age standard deviation	13 (4, 19)	15 (4, 20)	15 (8, 19)	8 (3, 15)	.015
Unknown	116	27	31	58	
Average age of alters	40 (30, 49)	40 (31, 48)	43 (32, 52)	36 (30, 47)	.11
Unknown	16	1	2	13	
Max age of alters	50 (32, 59)	55 (34, 61)	54 (36, 59)	40 (30, 54)	.009
Unknown	16	1	2	13	
% alters living in Cook	100 (0, 100)	18 (0, 100)	100 (0, 100)	100 (50, 100)	<.001
Unknown	12	0	1	11	
Network effective size	1.00 (1.00, 1.75)	1.12 (1.00, 1.67)	1.00 (1.00, 1.68)	1.00 (1.00, 1.99)	.4
Unknown	12	0	1	11	
Network tie density	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	.5
Unknown	12	0	1	11	

Note. In general, sexual networks suffered from more serious missing data problem. We mainly focus on injection network results in the paper.

eTable 6. Table 5 in the manuscript with numbers of missing reported.

Variable	Census tracts in CRASs, N = 51	Other census tracts in Chicago, N = 747	*p*-value
Poverty rate	37 (31, 48)	18 (10, 27)	<.001
Per capita income	13,949 (12,427, 15,978)	26,421 (18,586, 43,094)	<.001
% White	5 (2, 11)	54 (10, 77)	<.001
% Black	90 (81, 95)	8 (2, 81)	<.001
% Hispanic	5 (2, 15)	13 (4, 43)	<.001
% No high school diploma	23 (19, 30)	13 (6, 23)	<.001
% Children (under 18)	30 (25, 33)	21 (16, 26)	<.001
% Vacant housing	19 (15, 24)	11 (7, 16)	<.001
% Long-term occupancy	25 (16, 29)	22 (14, 32)	>.9
Foreclosure rate	23 (22, 25)	12 (7, 21)	<.001
Unkown	19	223	
Traffic volume	5.00 (4.50, 5.38)	5.00 (4.60, 5.50)	.3
Unkown	1	42	
Property crime per 1000	46 (31, 59)	23 (14, 38)	<.001
Violent crime per 1000	88 (74, 110)	18 (11, 47)	<.001

Note. Median (IQR) was provided for each variable. P-value was calculated with Wilcoxon rank sum test.

eTable 7. Average travel distance (miles) for different activities per residential group.

Activity	Overall, N = 258	Suburban, N = 72	Transient, N = 77	Urban, N = 109	*p*-value
Drug purchasing	6.03 (3.41, 14.50)	13.51 (5.94, 21.34)	10.84 (6.92, 37.22)	3.62 (1.38, 5.12)	<0.001
Unknown	4	2	1	1	
Drug injection	4.91 (1.85, 11.60)	7.25 (2.85, 16.64)	9.89 (5.92, 37.00)	2.44 (1.01, 4.05)	<0.001
Unknown	7	3	2	2	
Meet sex partners	6.75 (2.67, 16.55)	6.92 (2.99, 17.51)	13.43 (8.02, 51.24)	3.16 (0.96, 6.74)	<0.001
Unkown	45	12	11	22	

Note. Median (IQR) was provided for each variable. P-value was calculated with Kruskal-Wallis rank sum test.

More information regarding KDE:

There are two important considerations when implementing KDE analyses, including the actual kernel used to weight the point locations of each activity and the bandwidth (h) of observations to be weighted by the kernel. One could specify different kernels as long as the selected one is symmetric and represents a continuous probability density function with a mean of zero and a bounded variance, for which popular choices are the Gaussian and Epanechnikov. We tried several kernels and found no substantial differences in the results. We thus presented our results with the widely used Gaussian smoothing. The second consideration regarding the bandwidth is more relevant as it determines the direction and the amount of smoothing. We explored several alternatives for the bandwidth (h) using Least Square Cross Validation (LSCV) schemes and ad-hoc criteria. Some of the LSCVs did not converge, but the ad-hoc criteria provided similar estimates to the ones obtained by the best LSCV approximations. As such, we reported the results using the ad-hoc criteria. The bandwidth h was obtained based on Equation (1), where σ represents the average variance of points across longitude (x) and latitude (y), and n refers to the number of point locations for each activity-group pair (e.g., drug injection for urban group). Having obtained the KDEs, ranges of activities were derived using KDE contours (the function gettverticeshr was employed). Based on the ranges of activities, we identified concentrated risk activity spaces (CRAS) within Cook and Collar counties where most activities took place for each residential group.

$$h = \sigma \cdot n^{-\frac{1}{6}};\ \sigma^2 = 0.5 \cdot (var(x) + var(y)) \quad (1)$$