Sampling Considerations for a Zika Virus Urosurvey in New York City

Corinne N. Thompson*[1], Christopher Lee[1,2], Stephen Immerwahr[3], Susan Resnick[4], Gretchen Culp[3], Don Weiss[1], Sharon K. Greene[1]

1: Bureau of Communicable Disease, New York City Department of Health and Mental Hygiene (NYC DOHMH); 2: Epidemic Intelligence Service, Centers for Disease Control and Prevention; 3: Bureau of Epidemiology Services, NYC DOHMH; 4: Informatics Technical Support, NYC DOHMH

BACKGROUND

- Though over 1,000 imported human Zika virus (ZIKV) infections were identified in New York City (NYC) in 2016 and a potentially competent *Aedes albopictus* vector is present, no local, mosquito-borne ZIKV transmission was suspected
- However, in the event of suspected local transmission, urosurveys can be used to detect ZIKV infections
- With a population of over 8.5 million and an average population density of 27,000 persons per square mile, it is not feasible to test the entire population of potentially exposed persons in many parts of NYC
- To support preparedness efforts, we developed a sampling plan for a urosuvery to substantiate no local, mosquito-borne ZIKV transmission in NYC

METHODS

- If two cases of laboratory confirmed ZIKV with no concerning travel history or sexual exposure occur within one mile then a 150m radius circle (i.e., flight distance of an *Aedes* sp. mosquito) will be drawn around residences to delineate suspected risk areas
- Given the variability in density and types of residential buildings across NYC (**FIGURE 1**), we selected three hypothetical suspected risk areas to inform both sample size and urosurvey operations response
- We developed a GIS application to estimate population size within a risk area (**TABLE ROW 1**) by quantifying the number of residential buildings and units (United States Postal Service 2014 data, **TABLE ROWS 2 & 3**) and mean census block household size (US Census 2010 data) for all doorways included in the 150m radius (**FIGURE 2**)
- We calculated the required sample size (**TABLE ROW 4**) based on a hypergeometric distribution and methods adapted from veterinary epidemiology[2] (R package FFD, function computeOptimalSampleSize)

Inputs for sample size calculations to substantiate freedom from disease from locally acquired, mosquito-borne ZIKV infection

> Estimated population size (varies, **TABLE ROW 1**)
> Maximum number of allowable missed cases = 10
> Test screening sensitivity = 93%
> Test screening specificity = 100%
> Significance level (alpha) = 0.05

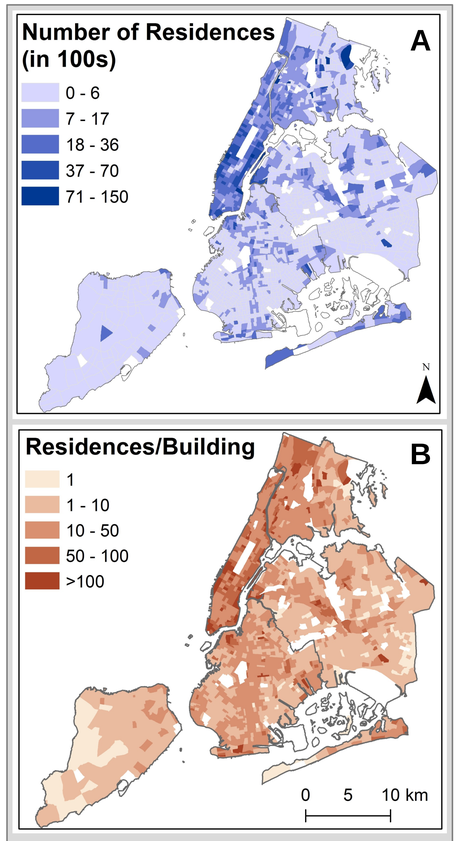

FIGURE 1. (A) Number of residences (in 100s) [natural breaks] and (B) ratio of number of residential units per residential building by 2010 census tract [manual breaks], New York City.

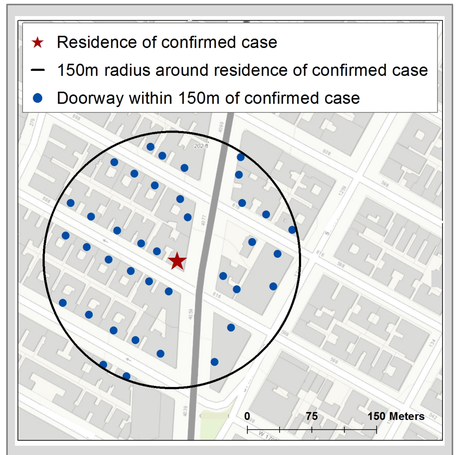

FIGURE 2. Residence of hypothetical confirmed case and all doorways within suspected risk area (150m radius).

- Number of people required to approach (**TABLE ROW 5**) assuming 50% response rate
- Number of households to approach (**TABLE ROW 6**) derived using mean census block household size (US Census 2010)

RESULTS

- Estimated population size within 150m radius of three example locations: range, 479–4,453 (**TABLE**)
- Minimum number of required samples: range, 133–1,244
- After accounting for non-response, the number of people to approach ranged from 266–2,488, corresponding to 83–968 households

TABLE. Sample sizes required to substantiate freedom from mosquito-borne, locally acquired ZIKV infection for a population living within 150m of three example locations, New York City

	Sample Size Considerations	Example location A	B	C
1	Estimated population size	479	4453	2338
2	Number of residential buildings	116	38	7
3	Number of households in suspected risk area	150	1648	1373
4	Minimum required number of samples	133	1244	653
5	People to approach	266	2488	1306
6	Households to approach	83	968	801

CONCLUSIONS

- Sampling is necessary to rule out locally acquired ZIKV transmission in a dense, urban environment like NYC
- Preparing a urosurvey sampling design requires detailed residential population geodata and specialized methods for rare events
- There is a necessary tradeoff of resource allocation and the degree of confidence that cases will not be missed

REFERENCE

1. Cameron & Baldock (1998) A new probability formula for surveys to substantiate freedom from disease. *Preventive Veterinary Medicine* **34** (1): 1-17.

***contact: cthompson2@health.nyc.gov**