# Spatiotemporal Analysis of the Relationship Between Socioeconomic Factors and Mortality Due to Nontraumatic Intracerebral Hemorrhage in New Orleans from 1880-1915

Ken Michael Porche MD; Sheridan Wright Kennedy
University of Florida; Rice University

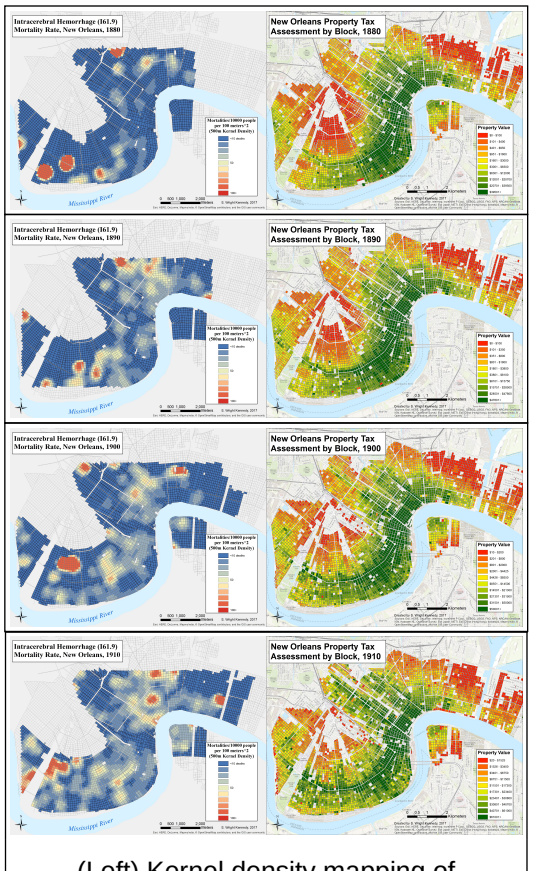
CNS 2017 ANNUAL MEETING
BOSTON, MASSACHUSETTS
OCTOBER 7–11, 2017

## Introduction

Intracerebral hemorrhage (ICH) has been shown to display variations in geographic distribution, age, and racial predisposition. Understanding spatial disparities in the association between socioeconomic factors and ICH are critical to targeted public health initiatives aimed to mitigate or prevent this disease. We sought to describe the historical trends of mortality due to ICH during a time of substantial growth in New Orleans (1880-1915). This analysis is part of the New Orleans Mortality Project, which brings together historical perspective and new spatiotemporal approaches to understand how health, environment, and socioeconomics impacted urban and community development in New Orleans, 1880-1915.

## Methods

As part of the New Orleans Mortality Project, we constructed a 50,000-person mortality database from death certificates, a 40,000-record property value database from tax ledgers, and >500,000 base-level population datasets from city directories. 1540 patients died of ICH (age 60.2 ± 15.8; 54.4% Male; 69.2% White). We built historical address locators to geocode these datasets. Eight time periods were analyzed at 5-year intervals from 1880-1915. Fisher exact tests were used for analyses of sex and race. Unpooled t-tests were used to compare age and land value.



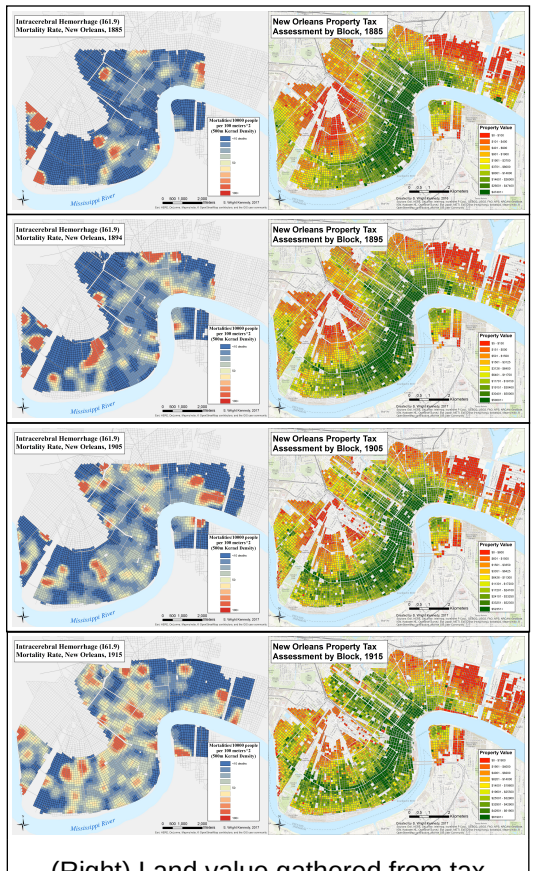

(Left) Kernel density mapping of nontraumatic intracranial hemorrhage as the cause of death.

### Demographics

| | | 1880 | | 1885 | | 1890 | | 1895 | |
|---|---|---|---|---|---|---|---|---|---|
| | | *ICH* | *ø ICH* | *ICH* | *ø ICH* | *ICH* | *ø ICH* | *ICH* | *ø ICH* |
| N | | 58 | 4569 | 98 | 5497 | 137 | 6267 | 167 | 5562 |
| Age (±SD) | | 57.2 (±16.5) | 27.0 (±26.8) | 60.2 (±15.5) | 31.8 (±27.8) | 60.5 (±14.7) | 33.7 (±28.2) | 60.1 (±16.0) | 32.6 (±27.9) |
| [in yrs] | *p* | <.00001 | | <.00001 | | <.00001 | | <.00001 | |
| Ethnicity | W:C | 2.63 | 2.45 | 1.97 | 2.80 | 2.26 | 2.67 | 2.11 | 2.60 |
| | *p* | 0.885 | | 0.106 | | 0.384 | | 0.253 | |
| Sex | M:F | 0.72 | 0.61 | 0.65 | 0.58 | 0.65 | 0.64 | 0.67 | 0.62 |
| | *p* | 0.178 | | 0.258 | | 0.334 | | 0.384 | |

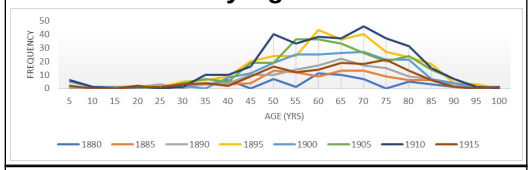
| | | 1900 | | 1905 | | 1910 | | 1915 | |
|---|---|---|---|---|---|---|---|---|---|
| | | *ICH* | *ø ICH* | *ICH* | *ø ICH* | *ICH* | *ø ICH* | *ICH* | *ø ICH* |
| N | | 170 | 7259 | 236 | 7410 | 257 | 7638 | 398 | 8107 |
| Age (±SD) | | 61.4 (±15.5) | 34.9 (±26.8) | 59.5 (±16.6) | 37.8 (±25.9) | 61.6 (±14.5) | 40.3 (±26.5) | 60.1(±16.5) | 42.6 (±25.8) |
| [in yrs] | *p* | <.00001 | | <.00001 | | <.00001 | | <.00001 | |
| Ethnicity | W:C | 2.07 | 2.16 | 3.05 | 2.60 | 2.88 | 2.17 | 1.89 | 2.04 |
| | *p* | 0.802 | | 0.336 | | 0.055 | | 0.512 | |
| Sex | M:F | 0.78 | 0.68 | 0.52 | 0.61 | 0.54 | 0.69 | 0.80 | 0.74 |
| | *p* | 0.213 | | 0.738 | | 0.522 | | 0.641 | |

Comparison of the count, sex, and race between those dying from nontraumatic intracranial hemorrhage and all others.




(Right) Land value gathered from tax records averaged over entire blocks.

### ICH Mortality Age Distribution




### Land Value Significantly Lower in Areas Found to be ICH Hotspots

| Year | Intracranial Hemorrhage | | | Population | | | Unpooled t test | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *N* | *μ* | *σ* | *N* | *μ* | *σ* | *SE* | *t* | *df* | *p* |
| *1880* | 80 | 3458.7 | 4155.9 | 4149 | 13387.4 | 38075.4 | 751.9 | -13.2 | 516 | <.00001 |
| *1885* | 107 | 2667.2 | 3749.5 | 4131 | 16400.5 | 50747.3 | 868.8 | -15.8 | 2217 | <.00001 |
| *1890* | 14 | 6143.2 | 4238.3 | 4045 | 17240.4 | 50265.9 | 1381.2 | -8.0 | 29 | <.00001 |
| *1895* | 106 | 3758.1 | 4549.5 | 4071 | 18192.2 | 48966.4 | 885.6 | -16.3 | 1372 | <.00001 |
| *1900* | 49 | 2316.6 | 2409.7 | 3843 | 20043.4 | 52270.2 | 910.7 | -19.5 | 1622 | <.00001 |
| *1905* | 30 | 5446.5 | 6790.0 | 3729 | 23757.2 | 172717.5 | 3088.1 | -5.9 | 922 | <.00001 |
| *1910* | 36 | 8246.0 | 7928.0 | 3607 | 28621.6 | 91086.6 | 2011.5 | -10.1 | 185 | <.00001 |
| *1915* | 36 | 13904.0 | 13562.0 | 3717 | 29157.1 | 84062.4 | 2647.7 | -5.8 | 66 | <.00001 |

Hotspots considered as blocks (N) with 100+ deaths per 10,000 people

## Results

- Increased rates of death due to ICH are shown along the periphery of population growth into areas of low income.
- Age was found to be statistically different for each year
- No statistical difference was found in sex or race

## Conclusions

Mortality due to ICH (although a heterogeneous diagnosis) has ties to socioeconomic status apart from race and sex as evidenced by its spatiotemporal evolution during the geographic expansion and urban sprawl of New Orleans, 1880-1915. This relationship can be extrapolated and further compared to modern day trends. Modern day causes include hemorrhagic conversion of stroke, cerebral amyloid angiography, hypertension, and vascular lesions.

## Future work

- Investigation of comorbidities in mortality database (i.e. heart disease, atherosclersosis)
- Kernel density regression analyses in order to better control for confounding factors and environmental factors
- Comparison of ICD-10 groupings of mortality in hotspots of ICH to all other areas to better understand the "mortality terrain" in these areas