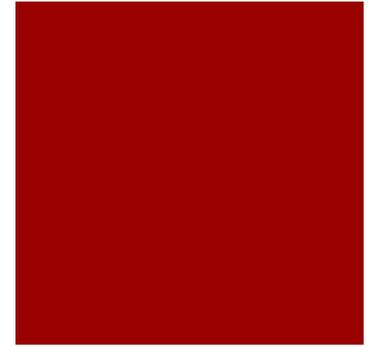


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AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

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Abstract Background. Recent studies have reported associations between particulate air pollution and daily mortality rates. Population-based, cross-sectional studies of metropolitan areas in the United States have also found associations between particulate air pollution and annual mortality rates, but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks.

Methods. In this prospective cohort study, we estimated the effects of air pollution on mortality, while controlling for individual risk factors. Survival analysis, including Cox proportional-hazards regression modeling, was conducted with data from a 14-to-16-year mortality follow-up of 8111 adults in six U.S. cities.

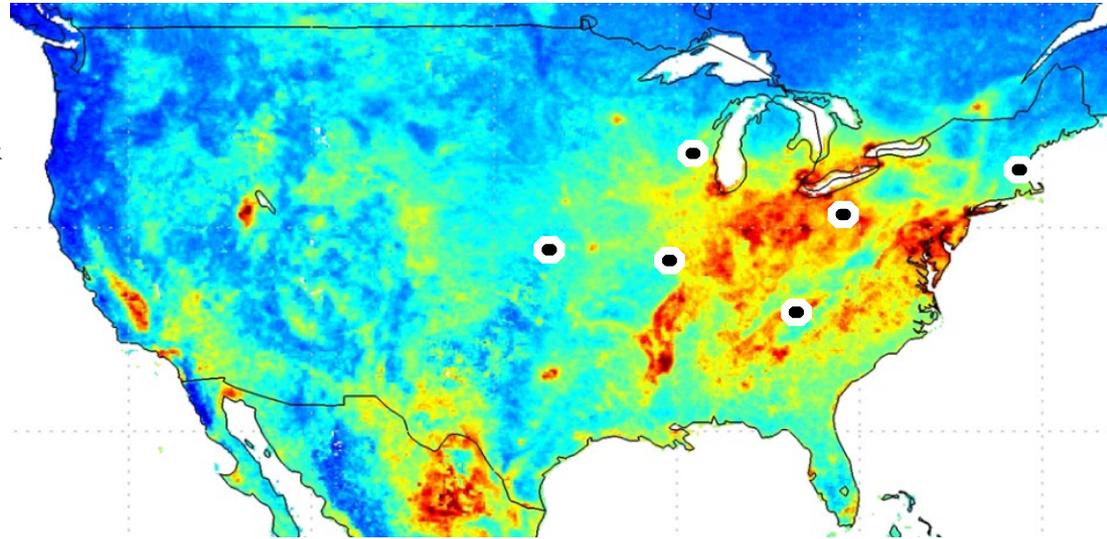
Results. Mortality rates were most strongly associated with cigarette smoking. After adjusting for smoking and

other risk factors, we observed statistically significant and robust associations between air pollution and mortality. The adjusted mortality-rate ratio for the most polluted of the cities as compared with the least polluted was 1.26 (95 percent confidence interval, 1.08 to 1.47). Air pollution was positively associated with death from lung cancer and cardiopulmonary disease but not with death from other causes considered together. Mortality was most strongly associated with air pollution with fine particulates, including sulfates.

Conclusions. Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities. (N Engl J Med 1993;329:1753-9.)

Six Cities Adult Mortality Study

- Random sample of 8111 adults in six cities
 - Dirty: *Steubenville, OH & St. Louis, MI*
 - Moderate: *Watertown, MA & Harriman, TN*
 - Clean: *Topeka, KS & Portage, WI*
- Enrolled 1974-77
- 14-16 years of mortality follow-up



Follow-up



HARVARD LUNG STUDY

REC'D 03-15-7

IS THE LABEL BELOW CORRECT? YES NO
IF NO, PLEASE MAKE CORRECTIONS.

Is the person named below too ill to complete this card? No Yes

Has the person named below died? No Yes

If yes, specify _____

Date of Death Feb. 12,

City/State of Death Steubenville
Ohio

9042-5

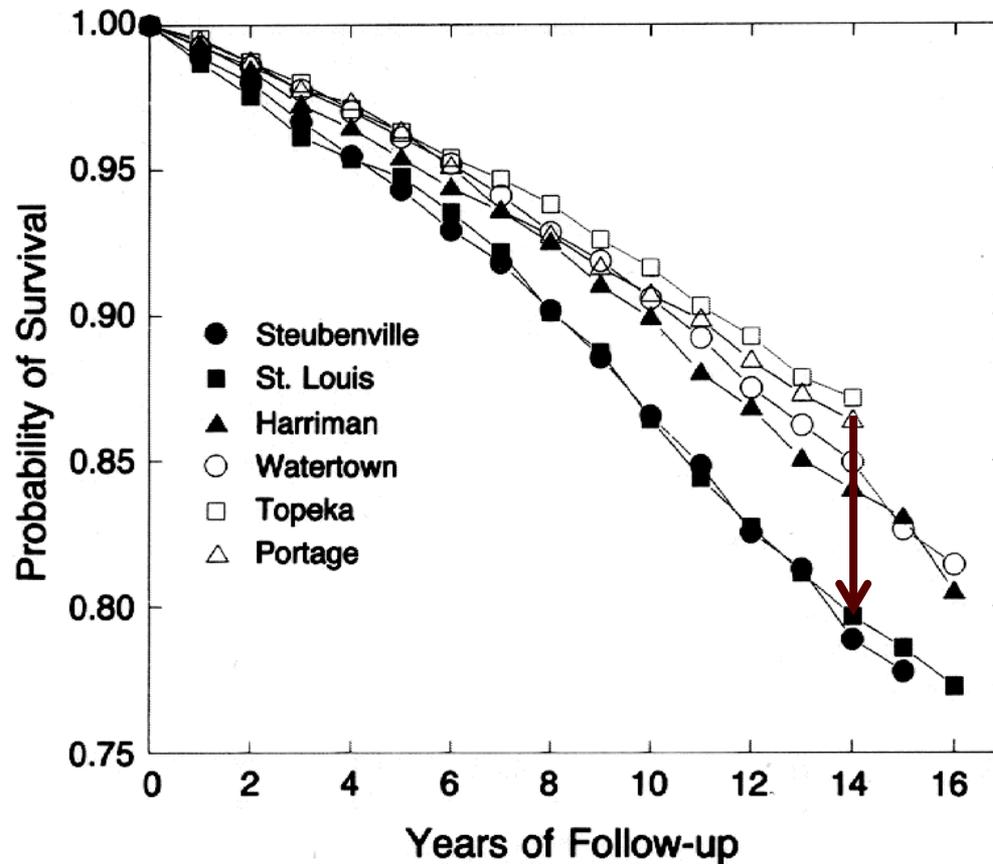
STEUBENVILLE, OH

43952

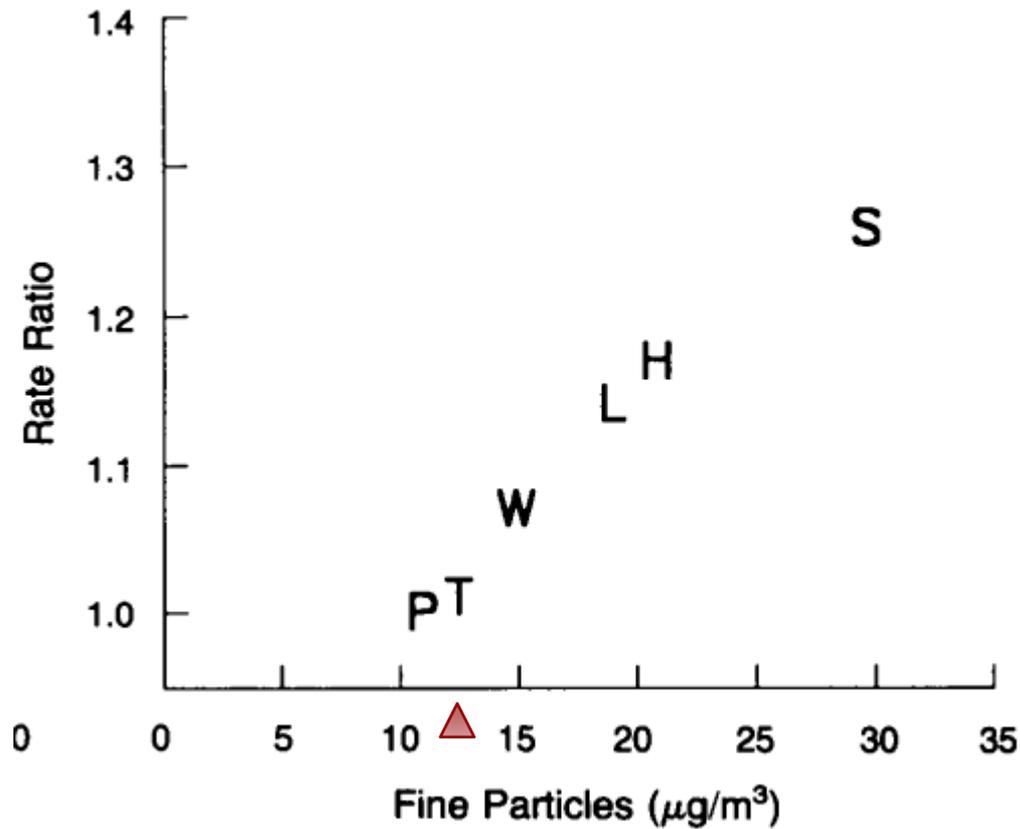
This card was completed by:
 Spouse Other Relative or Friend Person named above Other _____

Q.S.V.

Six Cities Adult Mortality Study



Six Cities Adult Mortality Study



8,111 subjects

Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults

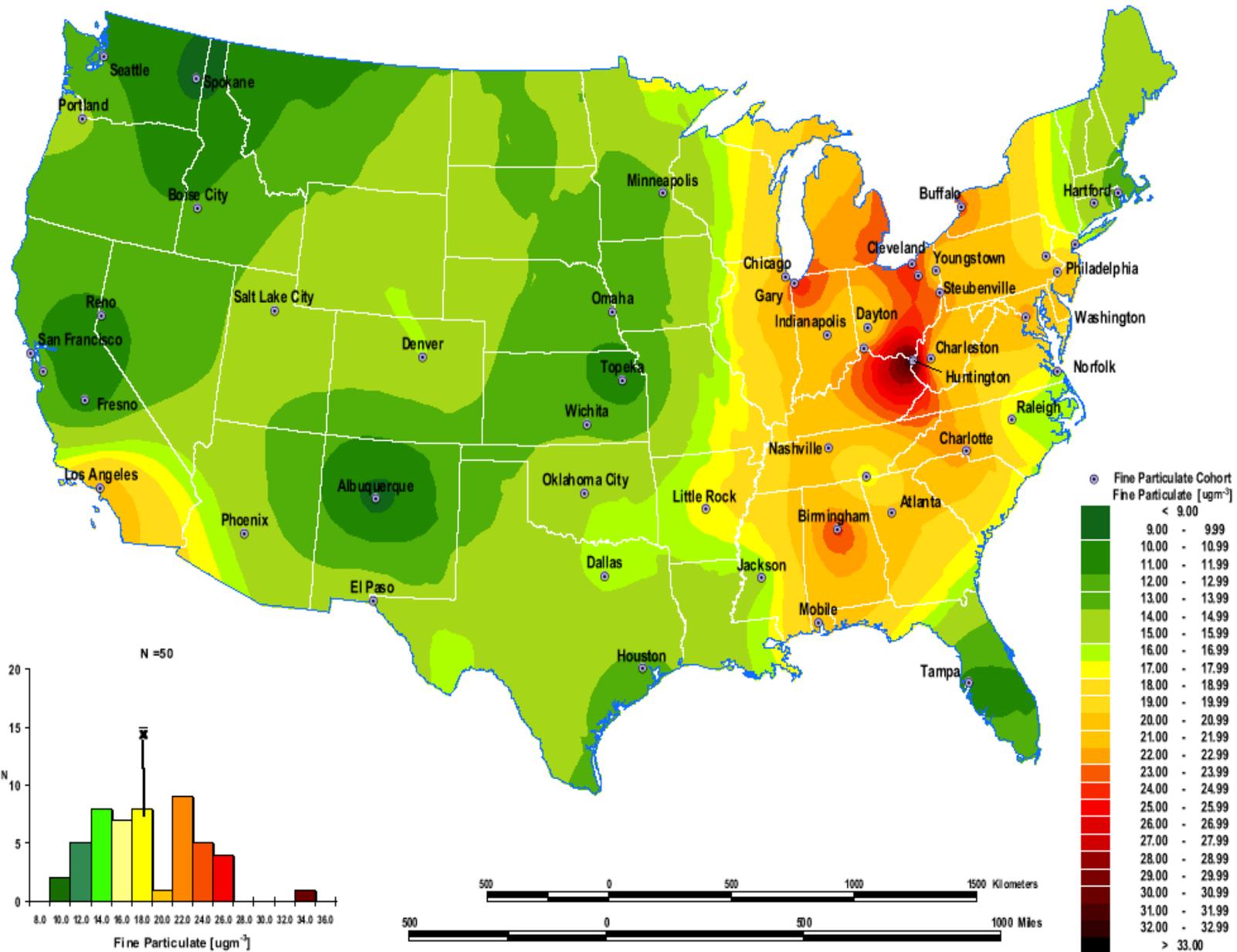
C. ARDEN POPE, III, MICHAEL J. THUN, MOHAN M. NAMBOODIRI, DOUGLAS W. DOCKERY, JOHN S. EVANS, FRANK E. SPEIZER, and CLARK W. HEATH, JR.

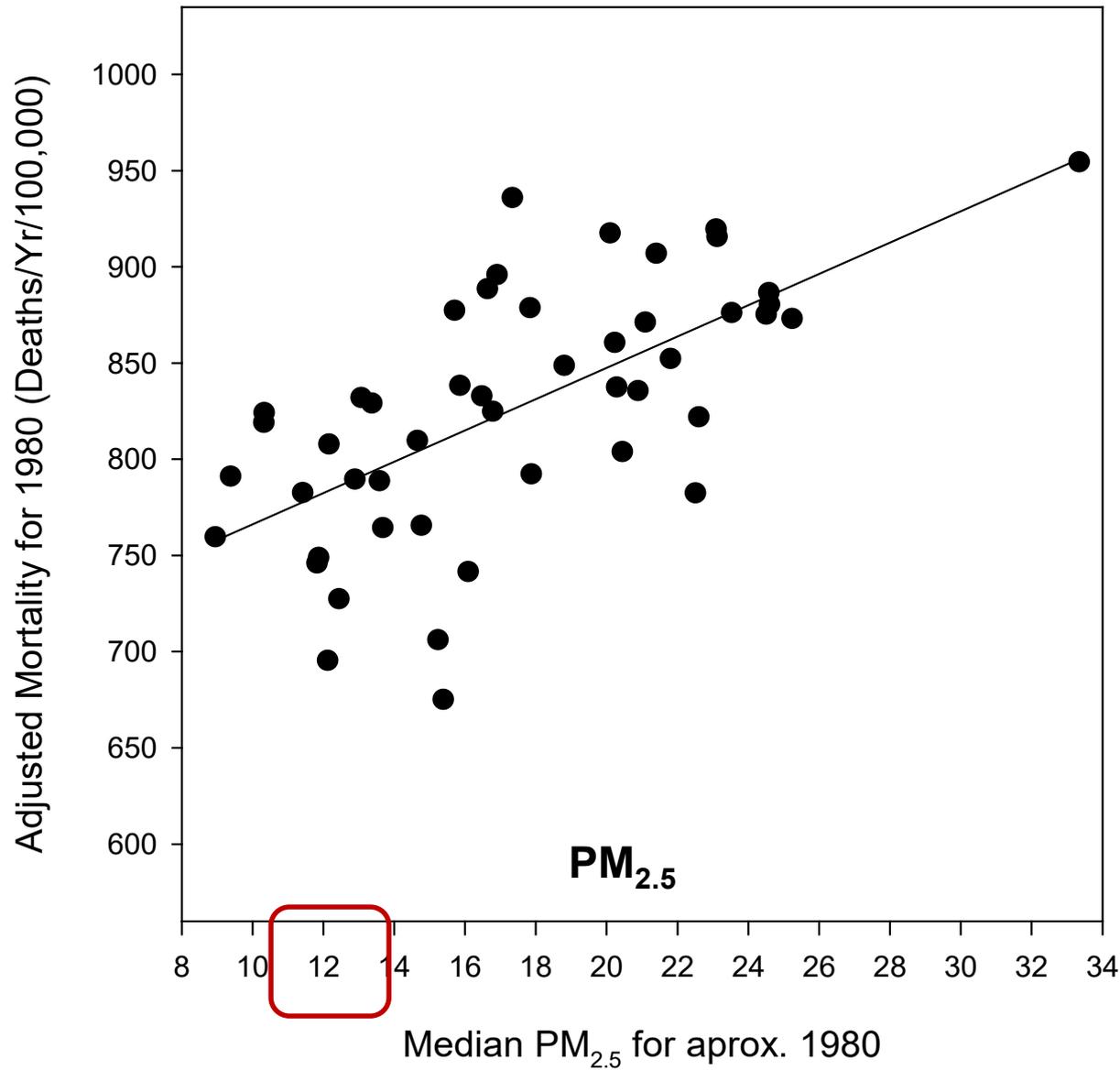
Environmental Epidemiology Program and Interdisciplinary Program in Health, Department of Environmental Health, Harvard School of Public Health, Boston, Massachusetts; Department of Epidemiology and Statistics, American Cancer Society, Atlanta, Georgia; and The Channing Laboratory, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts

American Cancer Society – Cancer Prevention Study II

- Existing prospective cohort
 - sample of entire US population
 - 1.2 million adults
- Matched by zip code to PM_{2.5} data
 - 1978-1983 EPA monitoring
 - 295,223 subjects
 - **50 monitors**

1980 Modeled Fine Particle Surface





Age-, sex-, and race- adjusted population-based mortality rates in U.S. cities for 1980 plotted over various indices of particulate air pollution

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Air Pollution and Mortality in the Medicare Population

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Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.

ABSTRACT

BACKGROUND

Studies have shown that long-term exposure to air pollution increases mortality. However, evidence is limited for air-pollution levels below the most recent National Ambient Air Quality Standards. Previous studies involved predominantly urban populations and did not have the statistical power to estimate the health effects in underrepresented groups.

METHODS

We constructed an open cohort of all Medicare beneficiaries (60,925,443 persons) in the continental United States from the years 2000 through 2012, with 460,310,521 person-years of follow-up. Annual averages of fine particulate matter (particles with a mass median aerodynamic diameter of less than $2.5 \mu\text{m}$ [$\text{PM}_{2.5}$])

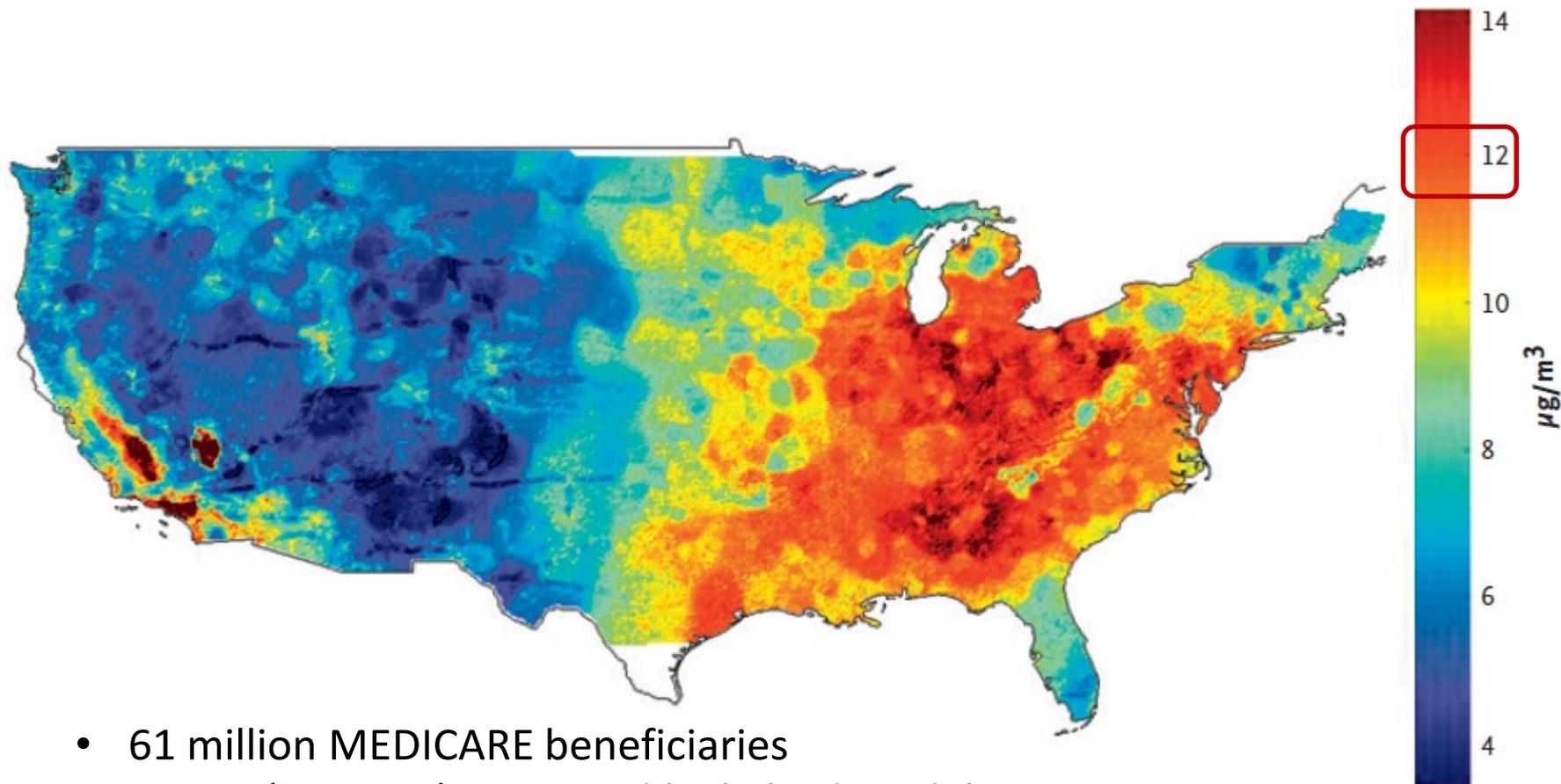
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A Average Concentrations of PM_{2.5}



- 61 million MEDICARE beneficiaries
- PM_{2.5} (2000-12) estimated by hybrid models
- **39,716** unique zip codes

A Exposure to PM_{2.5}

