

# Stronger Relationship Between Particulate Matter (PM) and Premature Death

March 23, 2006



**Air Resources Board**  

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**California Environmental Protection Agency**

# Overview

- ◆ Health Effects and confirmatory evidence
- ◆ Air quality standards and regulations are increasingly reliant on these study results
- ◆ Key studies of mortality effects (premature death)
- ◆ A new California-based study (Jerrett et al.) indicates we are underestimating mortality
- ◆ Implications for ARB Programs

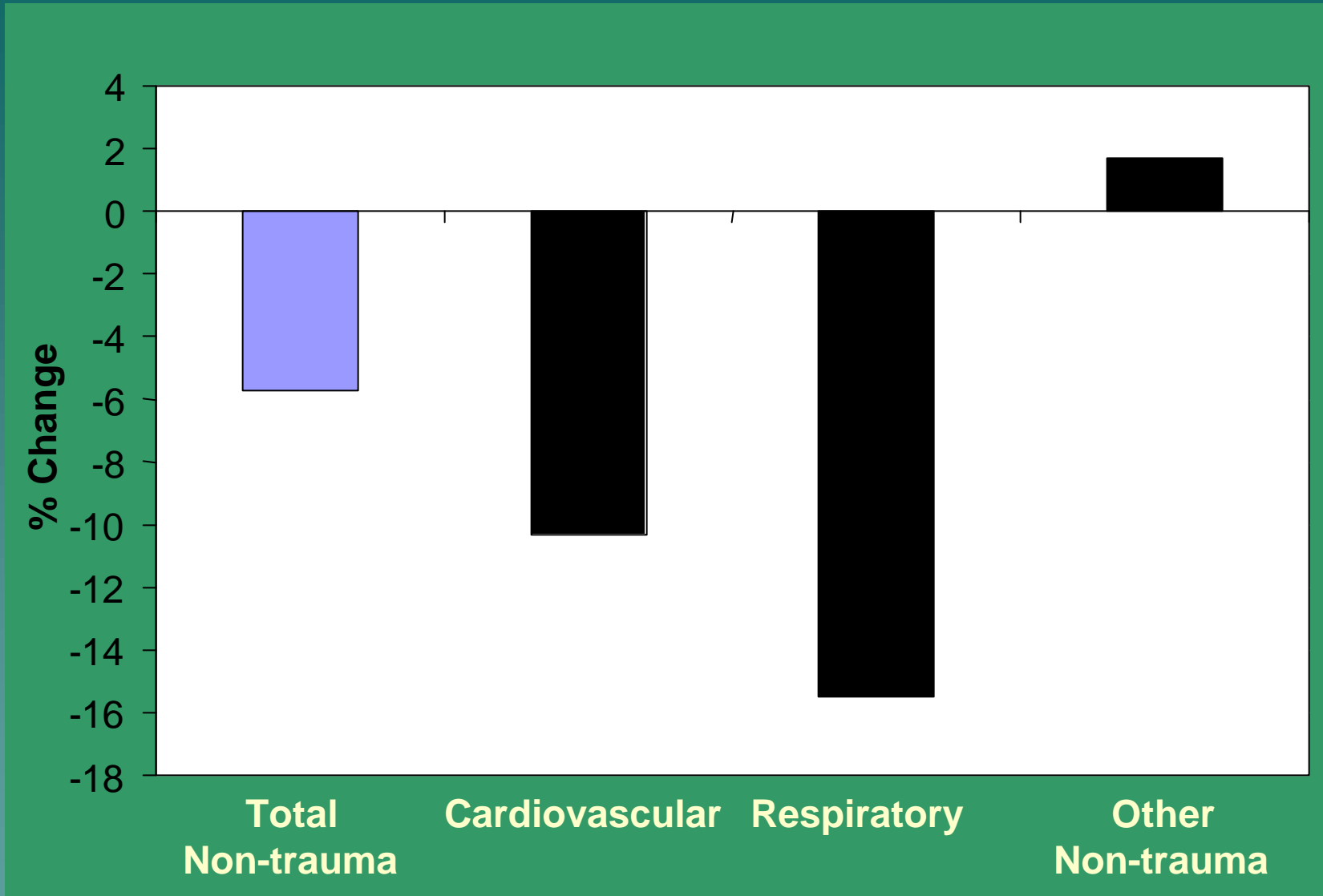
# What We've Learned to Date

- ◆ ~9,000 Californians die prematurely, in 2000, due to particulate matter and ozone exposure above State ambient air quality standards
- ◆ Exposures to air pollution can shorten life by about 14 years for people who die prematurely
- ◆ Value of preventing premature death is \$7.9 million (2005 dollars) by U.S. EPA
- ◆ Californian's have a disproportionate share of PM exposure

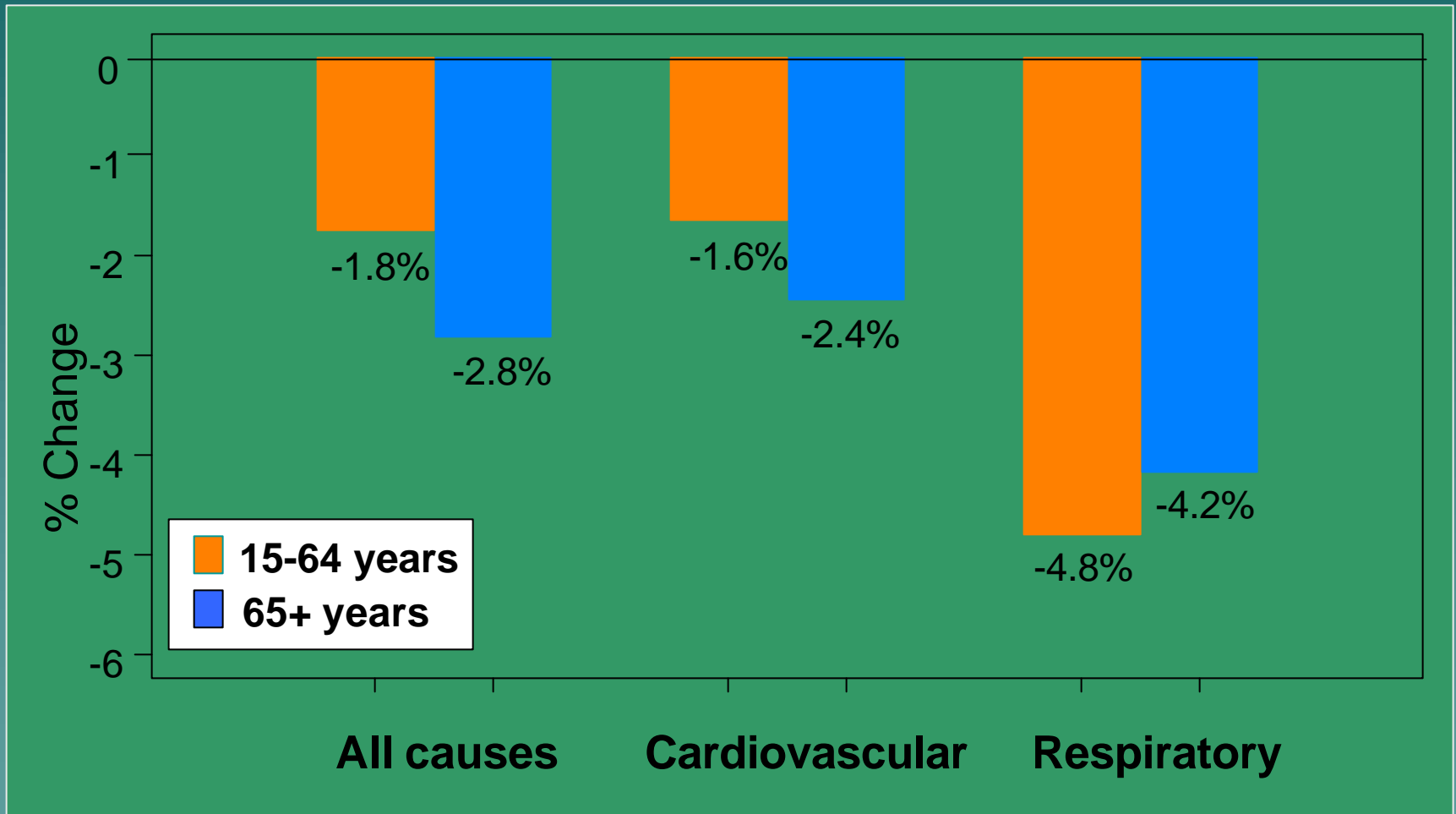
# Scientific Confirmatory Evidence

- ◆ Observed health improvements following significant emission reductions
  - Coal ban in Dublin, Ireland
  - Sulfur reduction in Hong Kong
  - Steel mill closure in Utah Valley
  - Children's Health Study

# Death Rates After Coal Ban, Dublin Ireland



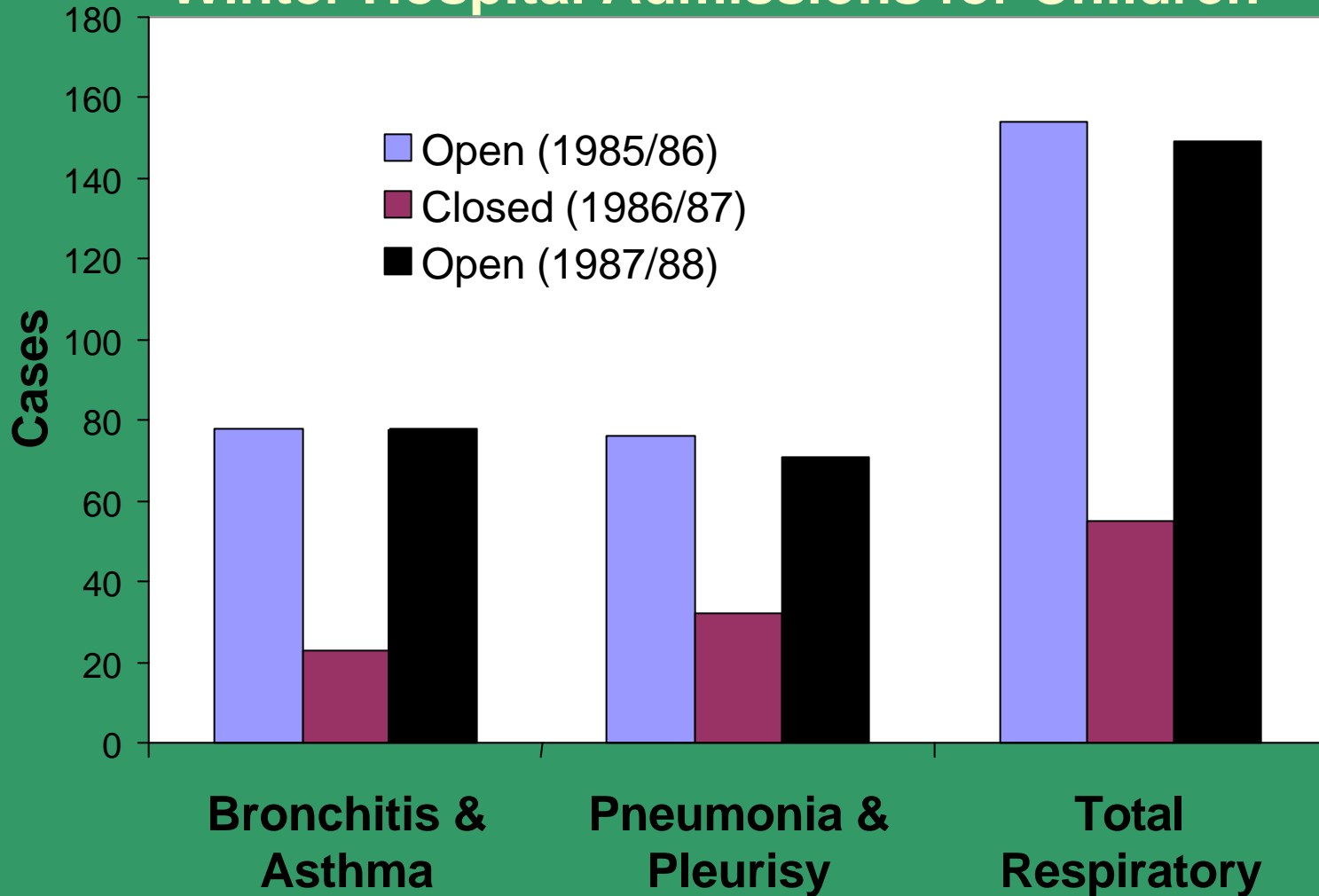
# Death Rates for Two Age Groups after Sulfur Restriction, Hong Kong



Courtesy of Robert O'Keefe, Health Effects Institute

# 13-Month Steel Mill Strike, In Utah

## Winter Hospital Admissions for Children



# Relocation and Lung Function, Children's Health Study California

- ◆ Children's Health Study followed relocated children from the larger study
- ◆ Decrease in PM10 exposure associated with an increase in lung function growth rate
- ◆ Increase in PM10 exposure associated with a decrease in lung function growth rate



# Support of ARB's Programs

- ◆ Set State particulate and ozone standards below the level of adverse health impacts and urged U.S. EPA to do the same
- ◆ Health benefits of State standard attainment
- ◆ Health benefits of adopting diesel control measures to cut PM exposure 85% by 2020
- ◆ Added "lives saved" to cost-effectiveness calculations

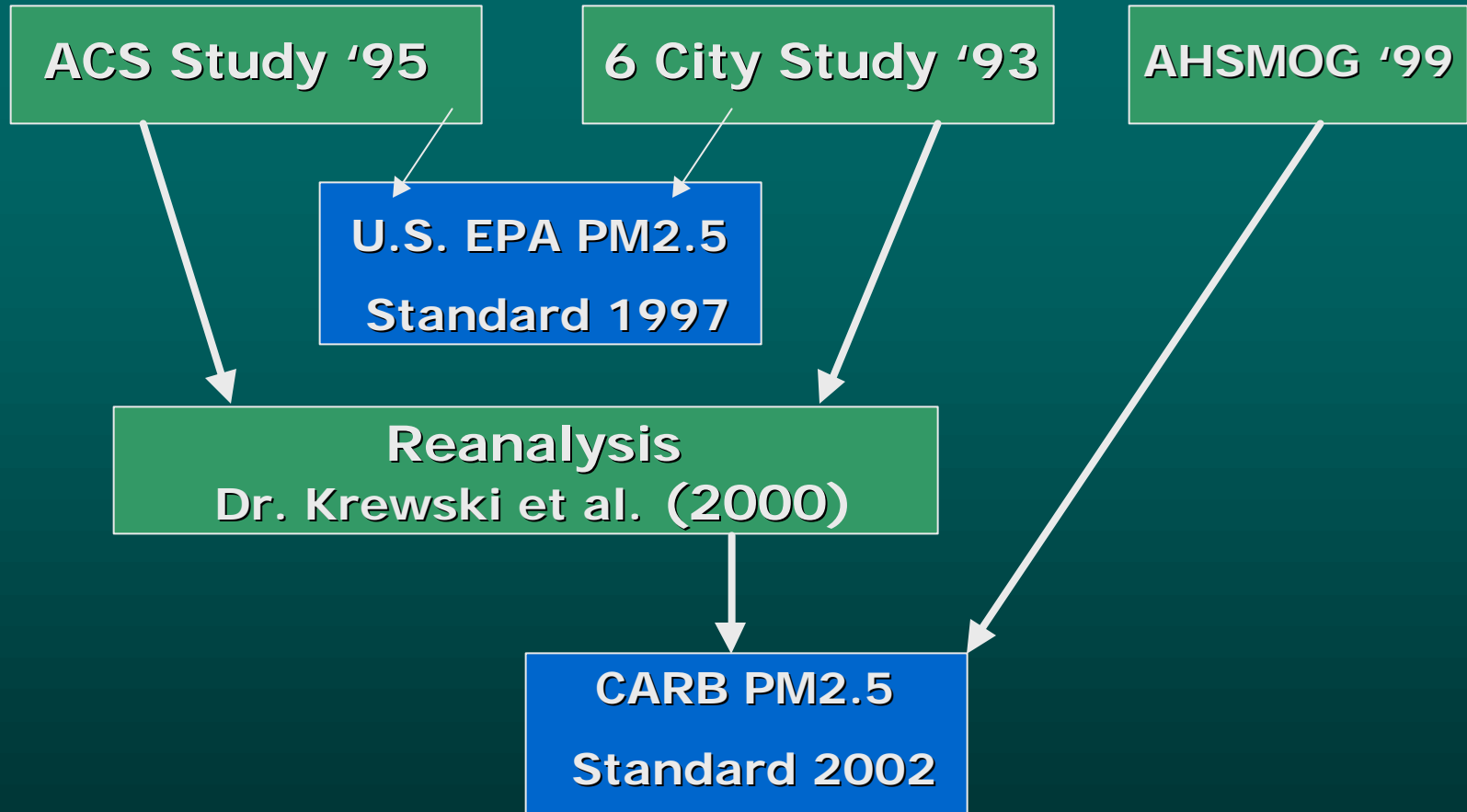
# Cost-Effectiveness

- ◆ Compare Health Benefits with Control Costs
- ◆ Methods endorsed by NAS, U.S. EPA, WHO
- ◆ Diesel PM Regulations
  - ◆ \$4 to \$28 of benefits per \$1 of control
- ◆ Goods Movement Plan
  - ◆ \$3 to \$8 of benefits per \$1 of control

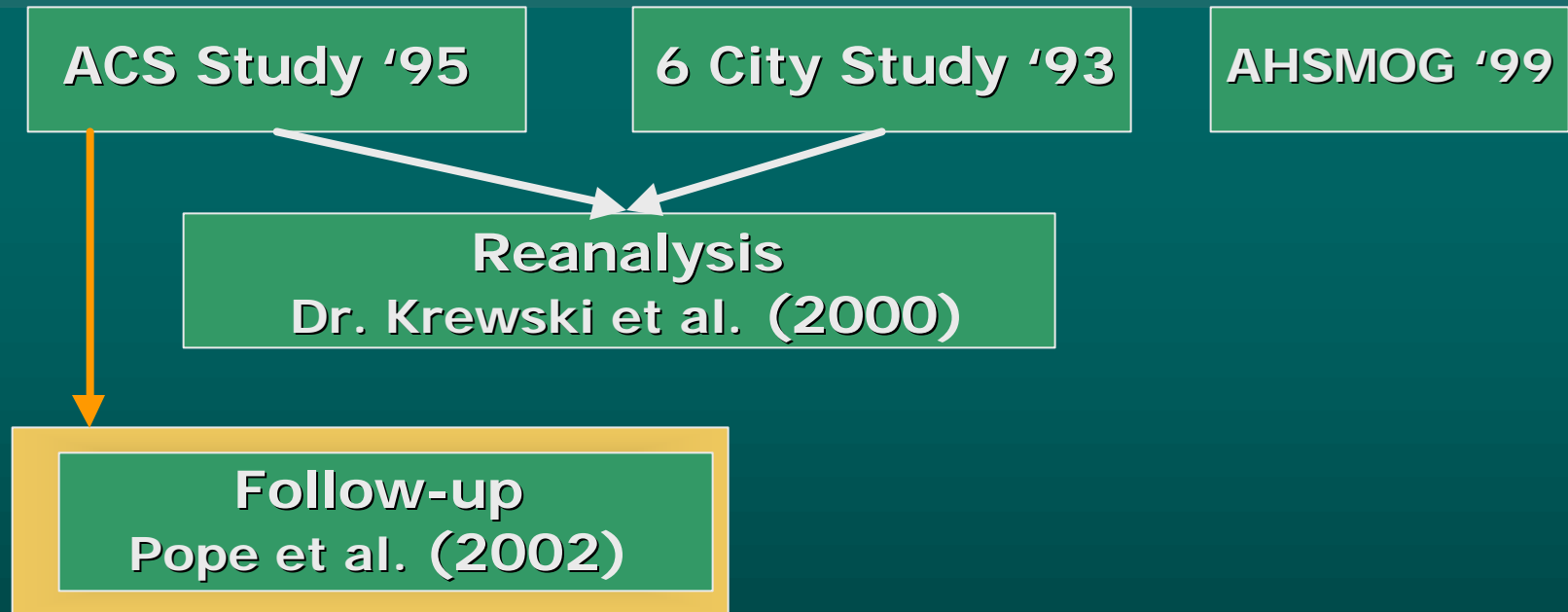
Where do These  
Numbers Come From?

Key PM Mortality Studies

# Progression of Key Health Studies

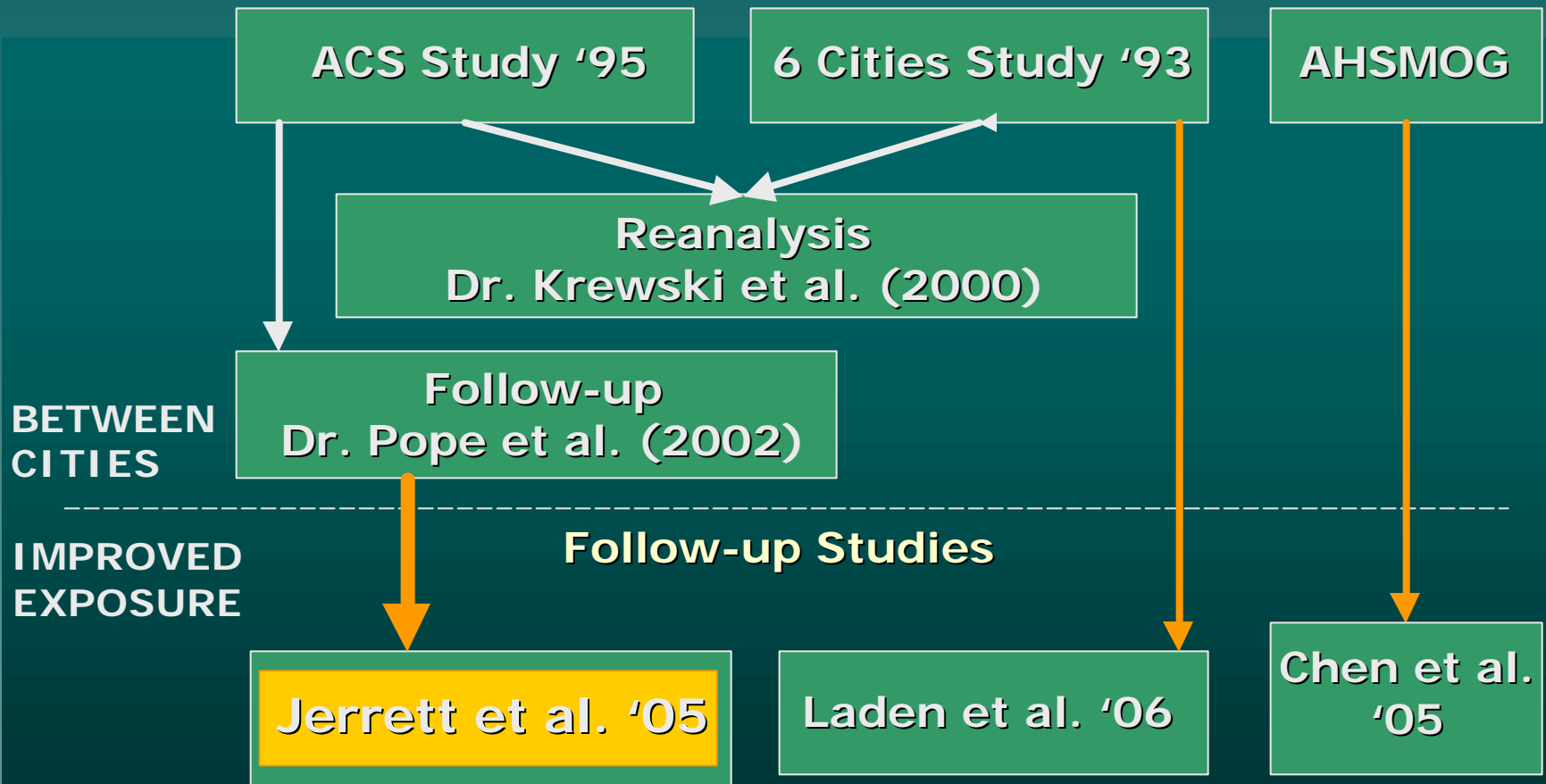


# Progression of Key Health Studies



- ◆ Follow-up study:
  - Yielded a higher risk of 6% for all cause of premature death for each increase of 10  $\mu\text{g}/\text{m}^3$  increase of  $\text{PM}_{2.5}$ .
  - Lung cancer association

# Follow-up Studies



# Spatial Analysis of Air Pollution and Mortality in Los Angeles

Jerrett et al. (2005)

# Study Population



## SAME

- ◆ American Cancer Society (ACS) Cohort
- ◆ 1982 at recruitment -both males and females were 30 or older
- ◆ Comprehensive questionnaire
  - Diet, smoking history, occupational, education, alcohol use, weight, etc.

## DIFFERENT

National

1982–1998

51 cities

500,000

versus

Los Angeles

1982–2000

LA region only

22,905

ACS Cohort Size



# Methods

## SAME

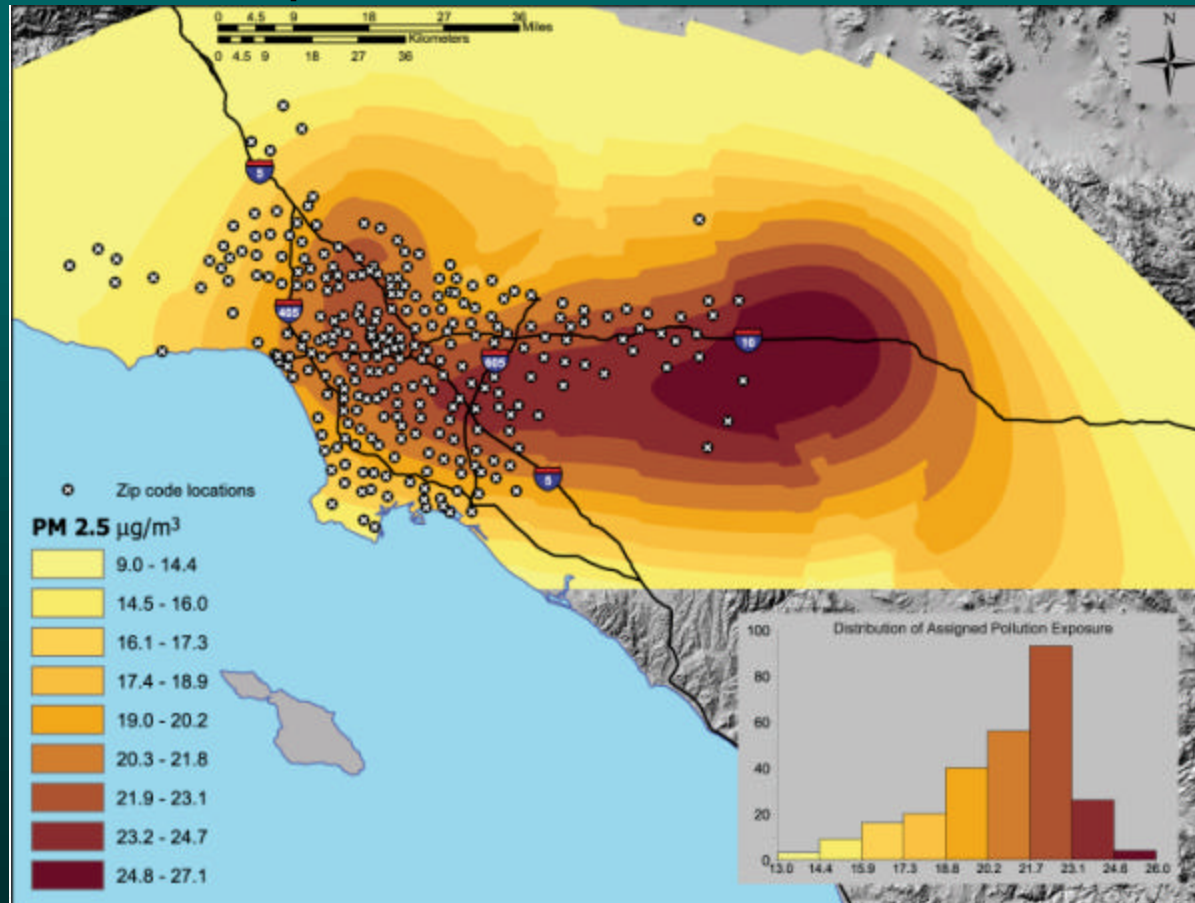
- ◆ PM2.5 only
- ◆ 44 confounders

## DIFFERENT

- ◆ LA study
  - Additional confounding factors such as income, education and crime rate
- ◆ Exposure
  - National: average PM2.5 for a city assigned same value to all participants in city
  - LA: PM2.5 data from 23 sites for 2000 then modeled and assigned to zip-codes

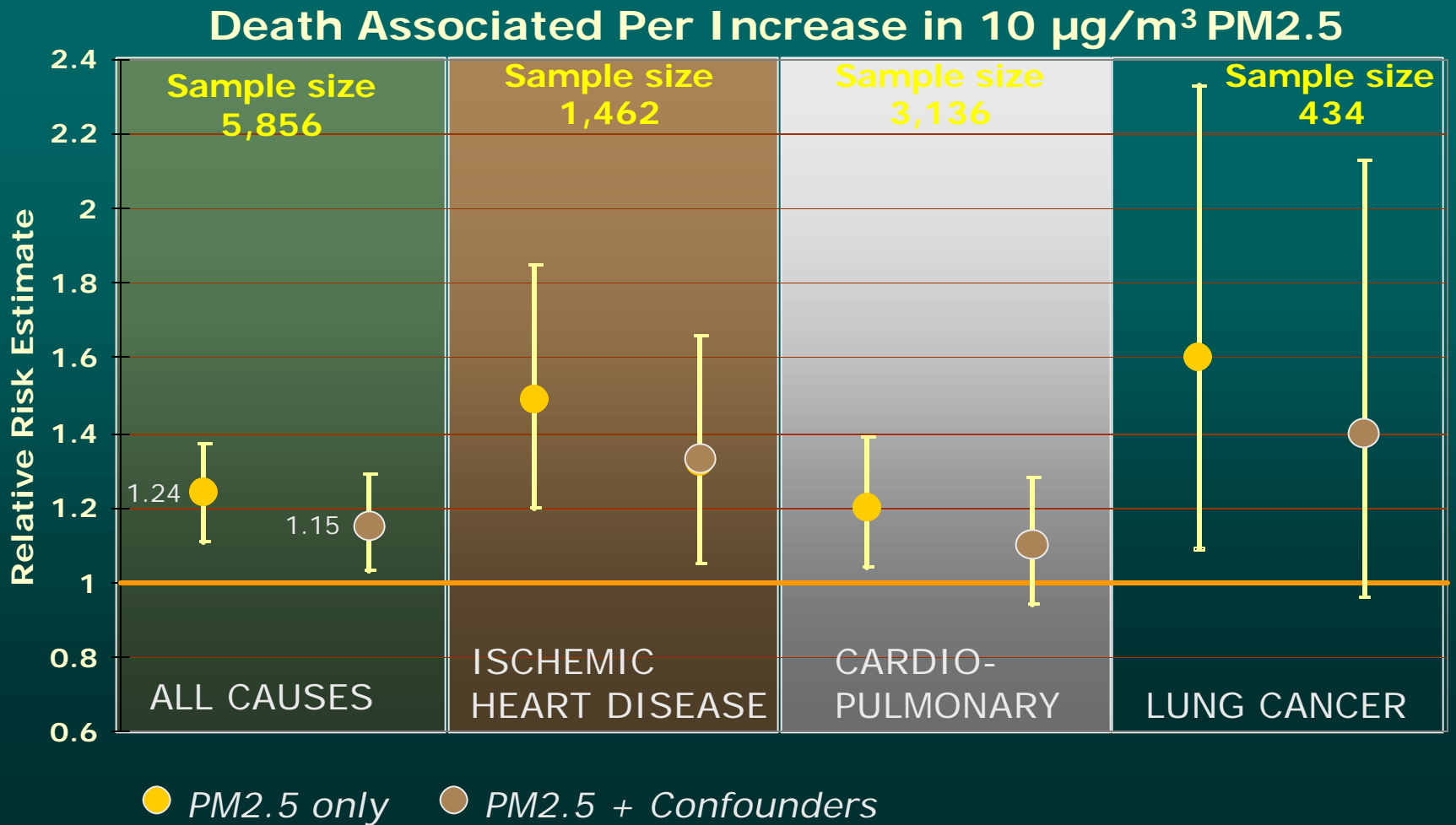
# Air Quality Data in Jerrett Study

## Interpolated Surface of PM<sub>2.5</sub>



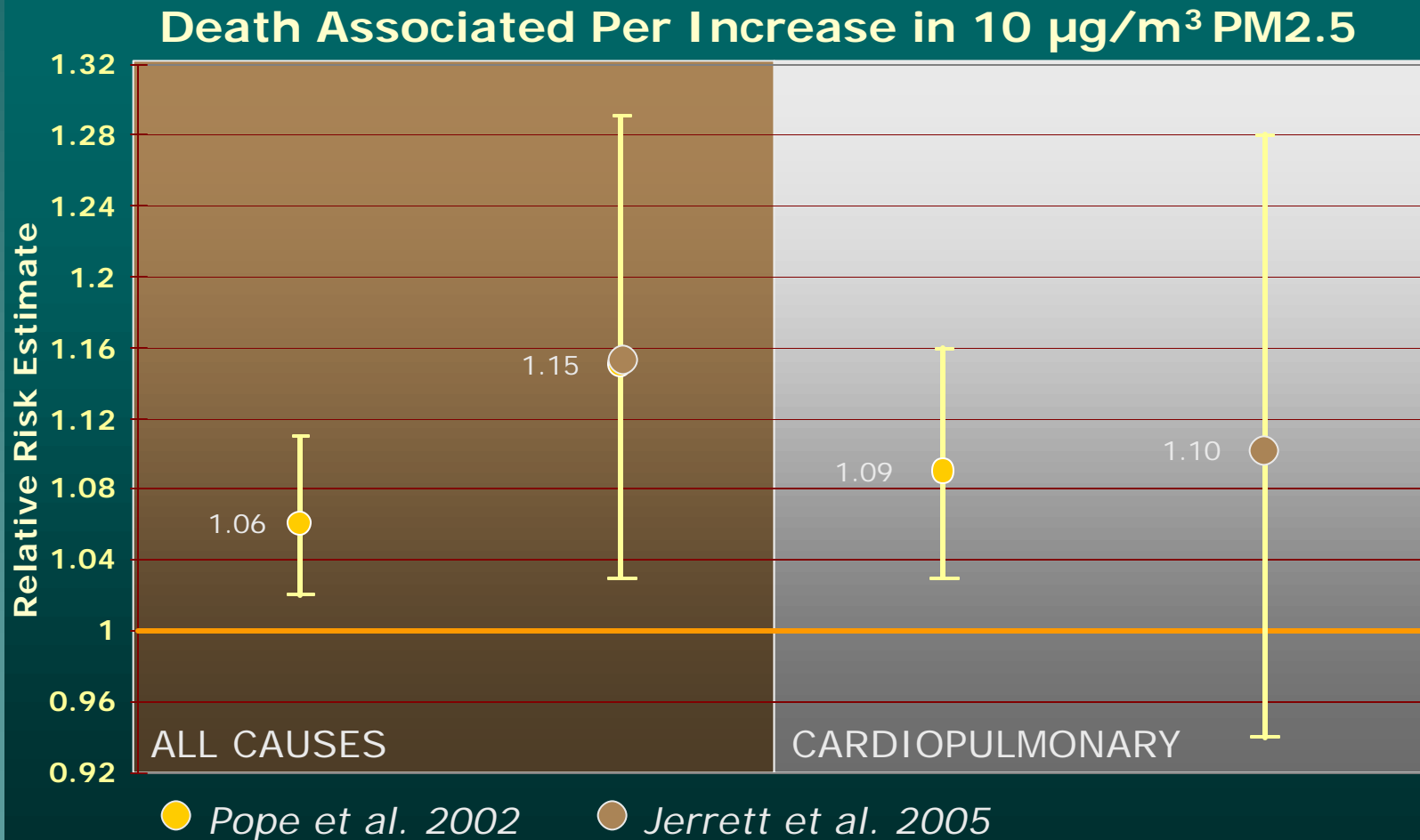
Courtesy of Dr. Michael Jerrett, USC

# Jerrett's Results



# Comparison of Results

National (Pope et al.) versus LA (Jerrett et al.)



# Summary of Jerrett's Results

- ◆ Within-city exposure gradients show PM<sub>2.5</sub> effects on premature death 2.5 x higher than across-city studies, but uncertainty range is wider
- ◆ Strongest effects from PM<sub>2.5</sub> with ischemic heart disease and all-cause deaths

# Strengths of Jerrett et al. Follow-up Study

- ◆ Studied real people in California environment
- ◆ More accurate PM exposure measurements
- ◆ More typical mixtures of air pollution, including freeway emissions
- ◆ Captured potentially vulnerable groups

# Weaknesses of Jerrett's work

- ◆ Less statistically robust
- ◆ Dividing analyses (cities, causes of death, sub-populations) increases range of uncertainty
- ◆ Not all potential confounders measured (stress, other pollutants)
- ◆ May not be representative of other CA regions

# Where the Science is Going?

- ◆ Supports general conclusion on association of PM exposure and premature death
- ◆ Strengthens association with cardiovascular impacts of PM
- ◆ Improves on exposure characterization
- ◆ Provokes issue of underestimation



# Next Steps

- ◆ Replicate in Other Large Cities
- ◆ Pooling
  - Blend strengths of LA study with greater statistical certainty of national study
  - Review results of new studies to be published later this year
  - Consistent methodologies with other environmental agencies
  - Peer review methodology

# Policy Implications

- ◆ Air Pollution Causes Premature Death
  - Greater share of total CA deaths than estimated to date, but range would widen
  - Will increase public demand for progress
- ◆ Particulate Matter Standards
  - Stronger support for standard attainment
  - Attainment provides larger benefits
  - Current CA standard protective enough

# Policy Implications, continued

## ◆ Diesel Regulations

- Health benefits greater than previously estimated
- More cost-effective than previously thought

## ◆ Communications / Public Education

- Need to get revision right and explain basis
- Message is not *“more people are dying”* but rather *“air pollution is the hidden cause of deaths that were previously attributed to other causes”*

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