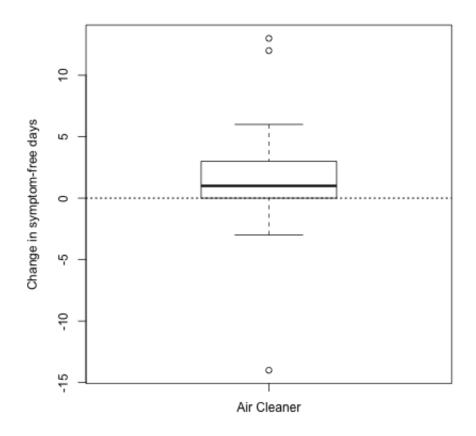


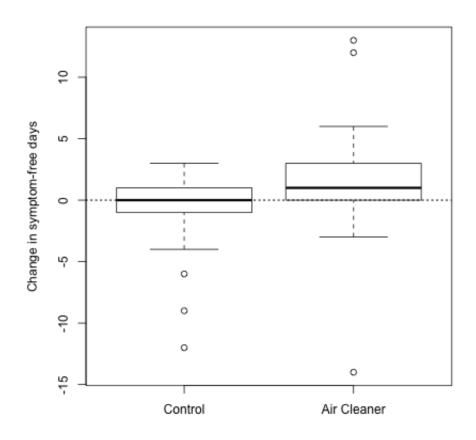
Roger D. Peng, Associate Professor of Biostatistics Johns Hopkins Bloomberg School of Public Health

- Principle 1: Show comparisons
  - Evidence for a hypothesis is always *relative* to another competing hypothesis.
  - Always ask "Compared to What?"

# **Show Comparisons**



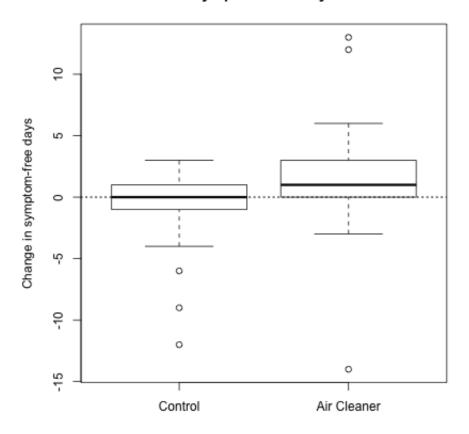
# **Show Comparisons**



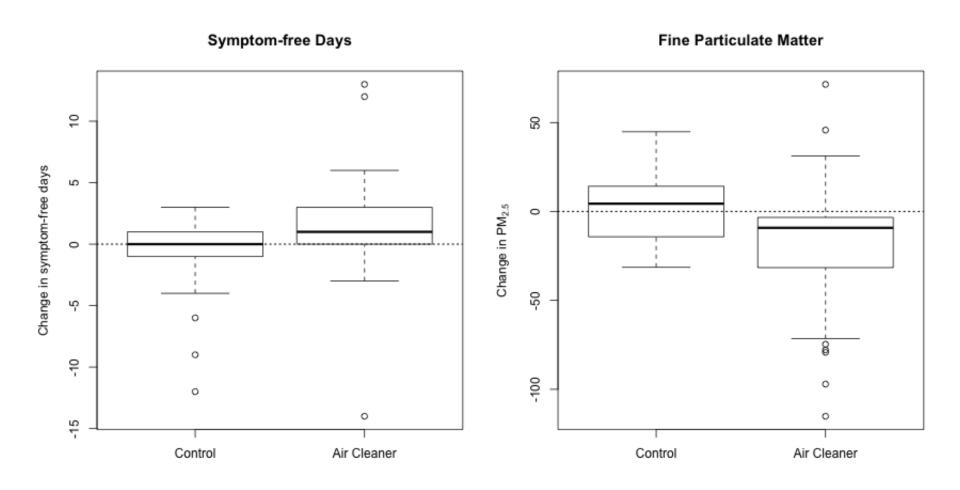
- Principle 1: Show comparisons
  - Evidence for a hypothesis is always *relative* to another competing hypothesis.
  - Always ask "Compared to What?"
- · Principle 2: Show causality, mechanism, explanation, systematic structure
  - What is your causal framework for thinking about a question?

# Show causality, mechanism

#### Symptom-free Days

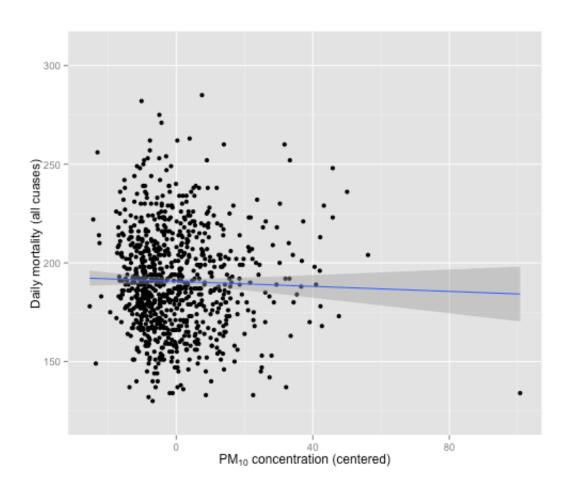


# Show causality, mechanism

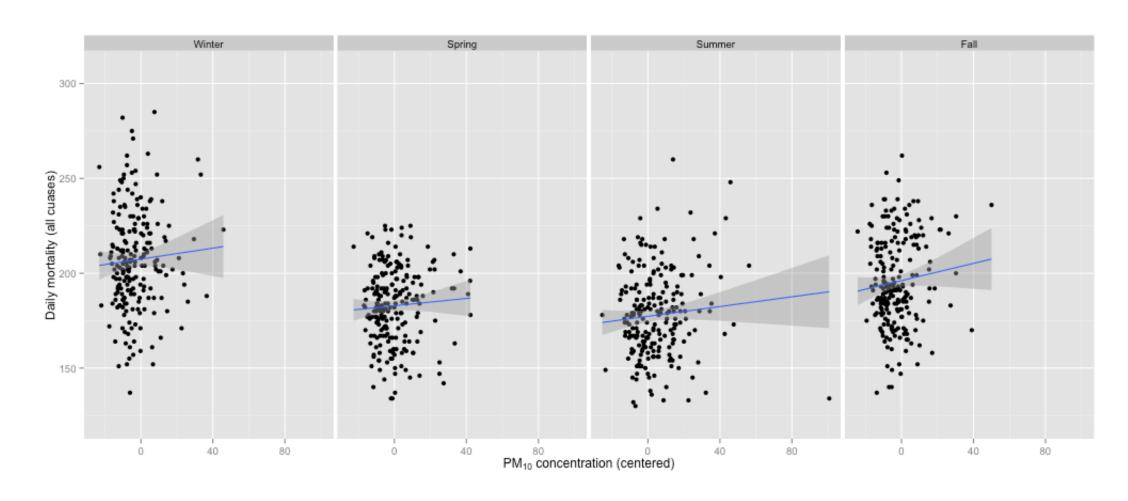


- Principle 1: Show comparisons
  - Evidence for a hypothesis is always *relative* to another competing hypothesis.
  - Always ask "Compared to What?"
- · Principle 2: Show causality, mechanism, explanation, systematic structure
  - What is your causal framework for thinking about a question?
- Principle 3: Show multivariate data
  - Multivariate = more than 2 variables
  - The real world is multivariate
  - Need to "escape flatland"

#### **Show Multivariate Data**



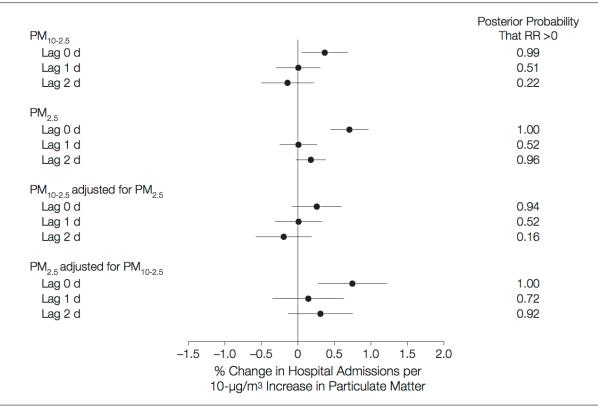
#### **Show Multivariate Data**



- · Principle 4: Integration of evidence
  - Completely integrate words, numbers, images, diagrams
  - Data graphics should make use of many modes of data presentation
  - Don't let the tool drive the analysis

#### **Integrate Different Modes of Evidence**

**Figure 2.** Percentage Change in Emergency Hospital Admissions Rate for Cardiovascular Diseases per a 10-μg/m³ Increase in Particulate Matter



Estimates are on average across 108 counties.  $PM_{2.5}$  indicates particulate matter is 2.5 µm or less in aerodynamic diameter;  $PM_{10}$ , particulate matter is 10 µm or less in aerodynamic diameter;  $PM_{10-2.5}$ , particulate matter is greater than 2.5 µm and 10 µm or less in aerodynamic diameter; RR, relative risk. Error bars indicate 95% posterior intervals.

- · Principle 4: Integration of evidence
  - Completely integrate words, numbers, images, diagrams
  - Data graphics should make use of many modes of data presentation
  - Don't let the tool drive the analysis
- · Principle 5: Describe and document the evidence with appropriate labels, scales, sources, etc.
  - A data graphic should tell a complete story that is credible

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- · Principle 5: Describe and document the evidence with appropriate labels, scales, sources, etc.
  - A data graphic should tell a complete story that is credible
- · Principle 6: Content is king
  - Analytical presentations ultimately stand or fall depending on the quality, relevance, and integrity of their content

#### **Summary**

- Principle 1: Show comparisons
- Principle 2: Show causality, mechanism, explanation
- · Principle 3: Show multivariate data
- Principle 4: Integrate multiple modes of evidence
- Principle 5: Describe and document the evidence
- Principle 6: Content is king

#### References

Edward Tufte (2006). Beautiful Evidence, Graphics Press LLC. www.edwardtufte.com