Health Effects of Air Quality Actions Across the Globe

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Accountability

- Goal of air quality regulations is to protect public health by implementing regulatory actions or by providing economic incentives that help reduce the public’s exposure to air pollution (e.g. Clean Air Act)
  - Air pollution should be reduced
  - Indicators of public health should improve

- Evaluation of extent to which air quality regulations succeed in protecting public health is deemed “accountability research”
Chain of Accountability

Fig. 1. Chain of accountability.
(Source: Health Effects Institute (Samet et al., 2003).)
Review of interventions to improve outdoor air quality and public health

Interventions to reduce ambient air pollution and their effects on health: An abridged Cochrane systematic review

J. Burns, H. Boogaard, S. Polus, L.M. Pfadenhauer, A.C. Rohwer, A.M. van Erp, R. Turley, E.A. Rehfueß

Evaluating the effectiveness of air quality regulations: A review of accountability studies and frameworks

Lucas R.F. Henneman, Cong Liu, James A. Mulholland, and Armistead G. Russell

Interventions to reduce ambient particulate matter air pollution and their effect on health (Review)

Interventions

- Short and Long term time scales
- Different pollutant sources and mixtures
- Different spatial scales
- Numerous health outcomes
- Retrospective versus Prospective Designs
Oil crisis in late 1970’s led to programs to encourage use of solid fuels, primarily coal.

1980’s - switch from oil to coal.

Dominant source of air pollution in Dublin was smoke from domestic fires.
- Deterioration in air quality after switch to coal
  \((Flanagan, 1986)\)
- During winters of 1980’s, Dublin experienced number of severe air pollution episodes.
- September 1, 1990 - Irish gov’t banned marketing, sale, and distribution of coal in Dublin
- Immediate reduction in monthly mean particle concentration
  \((Sinclair\ and\ Clancy,\ 1995)\)

-36 \(\mu g/m^3\) (-71%)

-11 \(\mu g/m^3\) (-34%)

-16% post-ban
Dublin Re-analysis

HEI
RESEARCH REPORT
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Effect of Air Pollution Control on Mortality and Hospital Admissions in Ireland
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Dublin Re-analysis

- Longer study period
- Previous analysis used cause-specific death rates across the rest of Ireland to control for confounding by long term time trend
- Used mortality rates in Coastal Counties to control for confounding by long term time trend
- Used Midland Counties (unaffected by Coal Sale ban) as a comparison county
- Change in mortality rates in Dublin
  - Respiratory Mortality: -17%
  - Cardiovascular Mortality: 0%
  - Total Mortality: -1%

Figure. Percent change in cause-specific mortality for the ban-affected and comparison counties after the 1990, 1995, and 1998 coal bans. CI denotes confidence interval.
Other European Accountability Studies

- London Congestion Charging Scheme
- German Reunification
- German power plant scrubber installations
Provo

Geneva Steel

Orem

Utah Lake

UTAH VALLEY, USA
2008 Beijing Summer Olympics

China promises to reduce air pollution levels to those of previous host cities during 47 day Olympics and Paralympics.
- 30-60% reductions in all pollutants (except O\textsubscript{3}) during 47 day Olympic period
- Among health young medical residents
  - Improvements in cardiorespiratory biomarkers during Olympics, with returns to baseline levels after the Games
Air pollution and Fetal Growth

Pregnancies with 8\textsuperscript{th} month of pregnancy during 2008 Olympics were, on average, 24 grams larger than pregnancies with 8\textsuperscript{th} month of pregnancy during same calendar dates in 2007 or 2009.
Evidence of health benefits from:

- Short term/temporary air quality improvements
  - Beijing, Utah Valley
- Long term air quality improvements
  - Ireland, Germany, Southern California

Several disease outcomes

- Mortality (Respiratory)
- Hospital Admissions (Cardiovascular, Respiratory)
- Cardiovascular Biomarkers
- Pregnancy Outcomes (Birth weight, Preterm birth)

Multiple Pollutant Sources (Industry, Traffic)

Multiple Spatial Scales (Urban, Regional, National)

Study design & statistical analysis difficulties are numerous
CAUTION: New York, US

- Increased PM toxicity AFTER air quality policies
- Air quality policies need to address PM composition and sources, not just total PM
Policy Impacts

- Using the “chain of accountability” provides a useful construct to assess the effectiveness of regulatory actions, but regulatory changes often overlap with (many) other changes and trends.
- Overall, AQ actions have improved air quality in the US, Europe, and Asia, but it continues to be useful to examine what the health benefits have been, and how we might have done better.
- Accountability studies should continue to be explored as a means to assess climate policies, working to solve methodological challenges.
- Urban, Regional, and National level assessments needed.

Thank you!