Environmental Regulations and their Impact on Health

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22 Environmental Health Core Centers Nationwide

Columbia University Health Sciences
Emory University
Harvard University
Icahn SOM- Mount Sinai
Massachusetts Institute of Technology
New York University School of Medicine
North Carolina State U.
Oregon State University
Rutgers University EOHSI
Texas A&M
U. of Arizona
U. Of California, Davis
U. of Cincinnati
U. of Iowa
U. of Michigan at Ann Arbor
U. of North Carolina Chapel Hill
U. of Pennsylvania
U. of Rochester
U. of Southern California
U. of Texas Medical Branch at Galveston
U. Of Washington
Wayne State U.
COEC Promotes Relationships and Facilitates Action Among Stakeholders
Objectives

- Define the benefits to human health of environmental regulation
- Describe existing federal environmental health regulation and the process of rule making
- Understand the role of state environmental regulation
- Apply an understanding of the limitations in current environmental regulation and their environmental health impact
Diseases Impacted by Environmental Exposures

- Asthma
- Lung Disease
- Cardiovascular Disease
- Autism
- Breast Cancer
- Cancer
- Lupus
- Parkinson’s Disease
- Neurologic Disorders
- Reproductive Outcomes
Jan 1, 1970 Richard Nixon signs the National Environmental Policy Act

“The 1970s absolutely must be the years when America pays its debt to the past by reclaiming the purity of its air, its waters, and our living environment,” -Richard M. Nixon
How effective has the Clean Air Act been?

- In first 20 years it prevented 200,000 premature deaths and 700,000 cases of chronic bronchitis
- Total emissions from 1990-2010 of the six criteria air pollutants decreased by 41% while US GDP increased 64%
- 1990 CAA amendments will prevent an additional 230,000 premature deaths by 2020

Mission Accomplished?
EPA’s Air Quality Index (AQI):

Tool for forecasting high pollution days

Measures five most common air pollutants daily

Color-coded scale of 0 to 500, the higher the value the higher the pollution

AQI can be found at www.airnow.gov
Current PM AQI
Monday, September 04, 2017 2:00 PM EDT

Today’s AQI Forecast
Thursday, July 07, 2016
Clean Air Act Compliance

- National Ambient Air Quality Standards
  - Particulates
  - SO2
  - Nox
  - Ozone
  - CO
  - Pb

Source: US EPA
Does Noncompliance with Regulation = Negative Impacts on Health?

......or is the regulation too strict?
Clean Air Act requires review of the science every 5 years

December 14, 2012 EPA revised PM 2.5 standard from 15ug/m3 to 12 ug/m3
Estimated Number of **Avoided** PM2.5 Health Impacts per year

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<tr>
<th>Health Impact</th>
<th>12 ug/m3</th>
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<tr>
<td>Non-Fatal Heart Attacks</td>
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<td>170</td>
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<tr>
<td>Hospital Admissions Respiratory</td>
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<tr>
<td>Hospital Admissions Cardiovascular</td>
<td>140</td>
<td>480</td>
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<tr>
<td>Emergency Department visits for Asthma</td>
<td>230</td>
<td>810</td>
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<tr>
<td>Asthma Exacerbations in Children</td>
<td>40,000</td>
<td>120,000</td>
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</table>

Data from Integrated Science Assessment for Particulate Matter 2010
Ozone: Secondary Pollutant

- Ozone forms from NOx + VOCs + sunlight

Ozone

- 2015 EPA reduced ozone standard from .075 to .070 ppb

Clean Air Scientific Advisory Committee concluded that the science supports a standard within 60 ppb – 70 ppb

Bell, ML; Peng, RD; Dominici F. http://www.ehponline.org/ambra-doi-resolver/10.1289/ehp.8816

IARC: Air Pollution Causes Cancer

- 2013
- Air Toxics

Combustion derived carcinogens
- diesel particulate
- formaldehyde
- benzene
- polyaromatic hydrocarbons
- polychlorinated biphenyls

Air toxics from other sources
- naphthalene
- acetaldehyde
- carbon tetrachloride
- vinyl chloride

38% of Americans are diagnosed with cancer during their lifetime

National Cancer Institute April 2017
https://surveillance.cancer.gov/devcan/
Number of People Living in Areas where the Estimated Cancer Risk from HAPs is Greater than 1 in 10,000

Map Legend:
Number of People Living in areas of

- **highest 20% of states**
- **second highest 20% of states**
- **middle 20% of states**
- **second lowest 20% of states**
- **lowest 20% of states**
EPA 2011 National Air Toxics Assessment

- Baltimore

NATA- considers only inhalation risk
EPA 2011 National Air Toxics Assessment

Legend

2011 Risks and Annual Ambient Concentrations
Cancer Risk and Respiratory Hazard Index

- Cancer Risk
  - 0 - 25
  - 25 - 50
  - 50 - 75
  - 75 - 100
  - > 100
- Zero Population Tracts

Risk is per million people

Philadelphia
NATA for Rural America

Montana

Wisconsin

UTAH

IOWA

Legend

2011 Risks and Annual Ambient Concentrations
Cancer Risk and Respiratory Hazard Index
- Cancer Risk
  - 0 - 25
  - 25 - 50
  - 50 - 75
  - 75 - 100
  - > 100
- Zero Population Tracts
Summary of Current Air Quality Regulation

- Federal standards are informed by science but lag behind science on the order of a decade
- Federal standards do not adequately protect human health
- Regulatory efforts are particularly unsuccessful in reducing risk in urban areas
- Science supporting additional regulation is not well known by health professionals and the public
How can physicians have an impact?

- Sign up for air quality alerts on [www.airnow.gov](http://www.airnow.gov)

- Advise your patients with any respiratory or cardiac illness to sign up too.

- Advise vulnerable patients to not engage in exercise on AQI orange or worse days.

- Talk with local officials and legislators about the scientific evidence about air pollution and its impact on your patients

- Get appointed to the local zoning board and limit air polluting industry in regions with poor air quality

- Help citizen groups understand air pollution and its effects on people
Exposures in Communities
Water
How effective has the Clean Water Act of 1972 been?

- Set water quality standards for surface water (rivers don’t burn any more)
- Required all discharges into navigable waters to have a permit
- Provided for the construction of publicly owned sewerage treatment plants throughout the country
- Required permits for draining and filling wetlands
Surface Water Quality

River after a storm

Combined sewer overflow
US Locations of Combined Sewer Overflow

Source: EPA Combined Sewer Overflow
Progress on CSO improvements

**Baltimore** 2 CS outfalls

- 2002 Federal consent decree to eliminate overflows by 2016
- Eliminate combined sewers
- Eliminate structures for the overflows

- 2016 still in progress, modified consent decree would allow for control of most of outflows by 2021

**Philadelphia** 164 CS outfalls

- 2012 Federal consent decree to implement Green City, Clean Waters Program to capture 85% of volume captured in CSS to ‘greened acres’ by 2037
Ongoing Challenges to Clean Water

- Combined Sewer Overflow
- Non-point sources

*Not addressed by the Clean Water Act*
How effective have Safe Drinking Water Act and amendments been?

- Established and enforced drinking water standards through Maximum Contaminant Levels (MCL’s)
  - 10% water systems remain out of compliance

- Requires that water purveyors test a variety of chemical and microbiological contaminants (100) on a regular basis
  - Many chemicals of concern are not tested

- Protects underground water sources
  - No requirement to test drinking water from private wells
EPA Unregulated Contaminant Monitoring

- Monitor up to 30 contaminants per 5 year cycle
- Representative sample of public water systems

### UCMR 3 Chemical Contaminants and Methods

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<tr>
<th>Contaminant</th>
<th>Contaminant Full Name</th>
<th>CAS¹ Number</th>
<th>Method ID</th>
<th>Method Name</th>
<th>Monitoring Requirement</th>
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</tbody>
</table>

¹Chemical Abstract Service

UCMR 3, January 2017
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Quality of Water from Public-Supply Wells in the United States

Patricia Toccalino and Jessica Hopple
USGS study of Public Drinking Water Quality

- Sampled 932 Public drinking water wells
- 30 Aquifers
- Tested for 337 contaminants
  - 44 inorganic (naturally occurring)
  - 293 organic (man-made)
1 in 5 source-water samples had concentrations greater than benchmarks

- Red: Greater than MCL or HBSL (22%)
- Blue: Greater than one-tenth of MCL or HBSL (58%)
Concentrations of the most common organic contaminants were similar in source and finished water.
Key Points USGS study of drinking water

- Current water treatment plants are not adequate to remove organic pollutants that are in water

- Massive update in water infrastructure is required

- Without improvement levels of organic chemicals in drinking water will certainly increase over time.

- Current Safe Drinking Water Act regulations alone are not adequate to protect human health
Lead and Copper Rule

- Lead and Copper Rule- 1991 EPA regulation requires utilities to test water from homes for lead.
  - if 10% of the samples exceed 15 PPB, the utility must enhance chemical anti-corrosion efforts. If this is inadequate, they must replace LSL until the percentage of tests exceeding 15ppb is less than 10%.

- Population based strategy-NOT health based standard
- Does not adequately assess the variability of lead over time
- Inconsistencies in testing techniques and inadequate sampling with high risk communities often under-sampled
- Contribution from water may not raise a blood lead level more than several micrograms on its own, however children with elevated levels due to lead in housing are made worse.
Lead in Drinking Water

Sources

- Pipe from water main to the curb
- Pipe from curb to your home (lead service line)
- Solder used before 1986 when lead was banned in plumbing can be 50% lead
- Brass faucets and valves installed before 2014 (can be up to 8% lead)

Given all of these sources—difficult to predict exposure for a patient
Scope of the lead service line problem

- 6.1 million lead service lines in US according to the American Water Works Association (down from 10.2 in 1991)

- 15-22 million people served by lead service lines

- $30 billion to replace all

- Other barriers: most municipalities consider the LSL to be homeowner property

- Public health officials often downplay LSL as a problem compared with deteriorating lead paint

- Unique circumstances such as digging in the street with vibrating tools or changing of adjacent pipes can lead to large debris in faucet filters.
Advice for Patients

Determine if they have a lead service line - find water line as it enters the house.

Identifying a lead service pipe

Tools needed: flathead screwdriver, refrigerator magnet

Lead - shiny when scratched
Not magnetic

Galvanized steel - stays dull when scratched
Magnetic
Advice for Patients with Lead Service Lines

- Only use cold water for drinking and cooking
- Run the water before consuming (1 min/50ft from water main)
- Use lead filters that are EPA certified
- Avoid water consumption when pipes on your street are being repaired and for 48 hours after
- Contact the water purveyor re: resources to replace the lead service line
Some municipalities have taken action

- Lansing, MI and Madison, WI have replaced every LSL

- Milwaukee, Boston, Philadelphia, Pittsburgh, Denver, St Paul have employed a mixture of strategies to reduce LSL: adding LSL replacements to municipal construction projects, offering homeowners payment plans and low interest loans

- Federal regulation is outdated on lead and inadequately protects public health
What about when there is almost no federal legislation?

HYDRAULIC FRACTURING
Hydraulic Fracturing: Marcellus Shale

- Half the land mass of Pennsylvania and almost all of West Virginia
- PA, WV, OH represent 3 of the top 5 states in terms of numbers of wells. TX and Ok are the other 2
- Drill head and pad 5-10 acre plot
- As of April 2017 in PA almost 18,000 permits (10,000 drilled)
- PA could accommodate up to 150,000
North Dakota Hydraulic Fracturing Landscape

Hydraulic Fracturing:
landscape changes, air, water, seismic
The Hydraulic Fracturing Process

Hydraulic fracturing, or “tracing,” involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.
Potential Impacts to People

- Air Pollution
- Water Contamination
- Motor Vehicle Accidents
2.5 Million Miles of Gas Pipeline in US 2016

- 88,000 miles in PA

Source: https://hip.phmsa.dot.gov
Who regulates HF exposures?

- Clean Air Act
- Safe Drinking Water Act
- Clean Water Act

State environmental protection agency

- State environmental regulations

State public health agency

- No environmental regulatory authority (except rodent control and food safety)

2005 Energy Policy Act exempted HF from underground injection control

Extremely variable state to state
EPA Controls on Air Pollution from the Oil and Gas Industry

- April 2012- EPA issues air rules under the Clean Air Act to reduce air pollution

- August 2015- EPA proposes additional requirements to combat climate change

- May 2016- EPA issues 3 final rules (New Source Performance Standards) curbing methane, VOC and air toxics from oil and gas sources (June 3, 2017 compliance date)

- June 12, 2017- EPA proposes a two year stay of NSPS

- Currently in court
Who regulates HF exposures?

- Clean Air Act
- Safe Drinking Water Act
- Clean Water Act

State environmental protection agency

- State environmental regulations

Extremely variable state to state

State public health agency

- No environmental regulatory authority (except rodent control and food safety)
Hydraulic Fracturing Wastewater Disposal

- 11 states allow wastewater to be used for ‘land treatments’ such as ice and dust control or road stabilization
- 12 states allow wastewater disposal in pits
- 9 states allow wastewater to be discharged to surface waters (often after treatment)
- PA allows all drill cuttings to be disposed of by land application
- MD allows same with departmental approval
Wastewater Pits

Map 14. Pit Liner Requirements

- Discretionary standard (1 state)
- Pit liner thickness requirement (mils) (21 states)
- Addressed in permit (4 states)
- No evidence of regulation found (5 states)
- Not in study

Top 5 states by number of natural gas wells (2011)
States with no natural gas wells (2011)

Source: US Energy Information Administration, Number of Producing Gas Wells, http://www.eia.gov/dnav/ng/nwdf_wells_s1a.htm
PA and WV have ‘aspirational’ standards that require operators to minimize gas waste or avoid harm to public health but have no enforceable requirement.
Current Problems with HF Regulation

- Variability leads to different risks in states
- Variability in data collection requirements is a barrier to scientific study
- Variability in enforcement provides for variable compliance
- State political climates have large impact on degree of regulation
Summary

- Current environmental regulation is informed by environmental science but is not adequately protective of health.

- Cumulative impacts on health are not well considered in the environmental regulatory process as evidenced by increased risk in urban areas.

- Making patients aware of environmental impacts on their health may empower them to participate in preventing exposures.

- There are emerging threats to health in drinking water that would benefit from physician engagement with patients, communities and regulators.
Cumulative Environmental Impacts
MOC Question 1

Which of the following are true about the National Ambient Air Quality Standards?

A. They are set by EPA’s Clean Air Scientific Advisory Committee

B. They are set to be protective of human health

C. The scientific evidence used to set them is reviewed every 5 years by the Clean Air Scientific Advisory Committee
MOC Question 2

Which of the following are benefits of regulating hydraulic fracturing at the federal level?

A. Consistent zoning could prevent the placement of drilling wells adjacent to schools

B. Application of best practices for hydraulic fracturing waste disposal could result in the elimination of unlined holding ponds

C. Uniform methods of data collection could provide accurate exposure information so that health studies could be done

D. All of the above
MOC Question 3

Why does the Lead and Copper Rule in its current form not adequately protect human health?

A. It was never intended to be a health regulation

B. It allows for water at an individual’s tap to have high levels of lead

C. The lead tests done may not be representative of the lead risk of the community

D. All of the above
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