The Public Health Implications of Marcellus Shale Activities

Bernard D. Goldstein, MD
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University of Pittsburgh
Graduate School of Public Health
bdgold@pitt.edu
Conventional and Non-conventional Natural Gas Extraction Methodologies

Schematic geology of natural gas resources

- Conventional non-associated gas
- Coalbed methane
- Conventional associated gas
- Sandstone
- Seal
- Tight sand gas
- Gas-rich shale
Marcellus drilling activity in PA to-date

Drilling Rig in Rural Upshur County, WV
Five Unanswered Questions About the Gulf Spill

Many important unknowns remain...

Exactly how much oil has leaked?

Where has all the oil gone?

Does the wellbore have good integrity?

Are underwater seeps from old wells common?

Why aren't there more dead animals?
Pathways to Adverse Health Impacts of Marcellus Shale Operations

- Worker health and safety
- Air pollution
- Water pollution
- Soil pollution
- Noise pollution
- Community safety: traffic, explosions, fires; crimes
- Psychosocial disruption
- Sustainability
- Global climate change
Questions Include

1. How is flow back and produced water disposed of?
2. Is the disposal of water affecting ground water or municipal and/or private drinking water supplies?
3. Water withdrawal and management?
4. Is there an additional burden to already compromised air quality in Southwestern, PA?
5. Movement of radionuclides?
6. What kind of stress and health issues are related to people living in communities where gas extraction and development activities are taking place?
7. How will pipelines and heavy road traffic affect the infrastructure of communities?
8. How long do well-casing last with corrosive fluids running through them?
9. What are the plans for emergency response?
ACCIDENT vs INCIDENT
Implications of the Gulf Oil Spill to Marcellus Shale Activities

- Environmental and human health are closely linked.
- Worker health and environmental health are linked by the culture of the workplace.
- Independent governmental oversight is necessary: and costs money that should be paid by the industry.
- Regulatory reform is required to better balance the protection of the environment and public health with business needs.
Center for Healthy Environments and Communities

Preliminary Findings

2010 Marcellus Shale Violations per Well
By Operator with 10 or More Total Marcellus Shale Wells

Violations per Well

Operator
Alcoa Lost Workday Performance
1987-2004

Per 200,000 work hours

1987 1.86
1988 1.48
1989 1.25
1990 1.11
1991 0.99
1992 0.81
1993 0.77
1994 0.75
1995 0.46
1996 0.49
1997 0.45
1998 0.36
1999 0.23
2000 0.18
2001 0.16
2002 0.15
2003 0.13
2004 0.07
Issues in Toxicological Testing of Fracking Compounds

• Fate and transport
• Hazard
  – To individual species; including humans
  – To ecosystem
• Dose
• Persistence
• Bioconcentration and biomagnification
• Degradation products
  – Of chemical
  – Of natural gas components following interaction with chemical
• Interactions with existing chemistry and geology of air, soil and water; and in waste streams
2. COMPOSITION/INFORMATION ON INGREDIENTS

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(see Satcher, D. *Public Health Reports* 125:6-7, 2010)
Usual Progression of Environmental and Occupational Issues Related to Human Health

1) Potentially harmful societal/industrial activities occur before all health and safety information is available

2) Report of adverse health outcomes potentially associated with activity

3) Major public concern

4) Inability to establish cause and effect relationship primarily because of inadequate exposure information
Problems with Retrospective Exposure Assessment

1. Expensive

2. Inaccurate
Major Recommendation

START THE EPIDEMIOLOGICAL STUDY NOW. BEGIN WITH ASSEMBLING THE COHORT(S) AND WITH ACCURATE EXPOSURE ASSESSMENT.
Other impediments to obtaining information relevant to the health effects potentially caused by Marcellus Shale activities
Impediments

• Lack of background information
• Failure to ask the right questions early enough
• Failure to look at entire public health picture
• Urgency of environmental/economic issues
• Failure to seek and engage local expertise
• Failure to evaluate actions and outcomes
• Multisectorial, multidisciplinary, multi-governmental, multi-everything else
• Unwillingness to say “I don’t know”
• Barriers caused by litigation
Contradictory Statements

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THE ONLY THREE CERTAINTIES

1) **Surprises**
Unforeseen threats to human health will be detected.

2) **Disease Clusters**
Clusters of adverse health effects will occur in communities in which Marcellus shale activity has occurred, whether causally related or not.

3) **Less Pollution Over Time**
Industry will find ways to recycle fracking chemicals (which they buy); and emit less of their product (which they sell).
THE ONLY THREE CERTAINTIES

2) **Disease Clusters and Law Suits**

It is certain that in a community with Marcellus Shale activity there will be a highly publicized statistically significant increase in a disease. This will result in worried community members, loss of property values and law suits. The concern will spread to other Marcellus Shale communities.

When this occurs Health Department or university epidemiologists will be asked to help determine whether the observed increase in disease incidence is a result of Marcellus Shale activity. This will require retrospective reconstruction of exposure to various chemicals. At best there will be a high degree of uncertainty in the exposure assessment that will complicate determination of cause and effect relationships.
What’s the Rush?

- Over time it is virtually certain that all the nation’s oil and gas sources, including the Marcellus Shale, will be tapped.
  - So what’s the rush?
Key Policy Issues Related to Human Health

• The need for vigorous governmental oversight
• Aggregate sources vs a single source (air sheds and water sheds)
• Individual risk vs community risk vs population risk
• Sustainability
Point Sources as Non-Point Sources

• Allowable emissions from the thousands or tens of thousands of Marcellus Shale sources easily exceed that of a major new point source (e.g., an oil refinery)

• Classically, non-point sources do not pose immediate risks in their neighborhood (e.g., nitrogen runoff from individual farms), but do so in aggregate (e.g., the dead zones of Chesapeake Bay or Gulf of Mexico)

• Marcellus Shale activities pose both local and aggregate risk

• They are being regulated solely as individual local point sources
NAAQS designations throughout PA, OH, MD, and WV
Drinking Water Health Issues

– Contaminants of concern to drinking water include:
  • Fracturing fluid chemicals
  • Degradation products
  • Naturally occurring materials in the geologic formation (e.g. metals, radionuclides) that are mobilized and brought to the surface during the hydraulic fracturing process
Watch out for TE-NORM
Technologically-Enhanced Naturally Occurring Radiation

• Naturally occurring radioactivity is not infrequently associated with oil and gas deposits

• Working these deposits can lead to the unanticipated concentration or displacement of radioactivity (e.g., will there be more radioactivity in drinking water? Will more radon be off-gassed into the basements of homes near a drill site?)
Crime and Police Response – PA

• "More and more, it seems the police reports coming out of the northern tier include arrests because of drug use and trafficking, fights involving rig workers, DUIs, and weapons being brought into the state and not registered properly," said the commissioner. "We've even encountered situations where drilling company employees who have been convicted of a sexual assault in another state come here to work and do not register with our Megan's Law website. Each of these issues is unacceptable and places an even greater burden on our law enforcement and local social programs meant to help those in need.“ (State Police Commissioner Frank Pawlowski)

• State and local governments need additional resources to address the problems that have accompanied the arrival of drilling companies to Pennsylvania.
Community Health Concerns and the Marcellus Shale

• Even if it were true that Marcellus Shale activities present no health risk it is unreasonable to expect that communities will be reassured by statements from industry asserting that their activities are safe.

• Safety statements from industry or government are particularly problematic given well-publicized Marcellus Shale incidents indicating an inability to fully contain the processes at all times.
Public Health Surveillance

• Public health surveillance is the continuous, systematic collection, analysis and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice.

• Such surveillance can:
  – serve as an early warning system for impending public health emergencies;
  – document the impact of an intervention, or track progress towards specified goals; and
  – monitor and clarify the epidemiology of health problems, to allow priorities to be set and to inform public health policy and strategies.

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Community Engagement

- Any attempt to understand and respond to the potential adverse health consequences of Marcellus Shale activities will fail unless the community is involved.
  - Causally related health impacts will be missed
  - Negative findings will be dismissed
Sustainability

• Requires transdisciplinary approaches to complex environmental issues.

• Approaches must include a comprehensive evaluation of environmental, economic and social/health issues. (e.g., in considering preventing on-site problems by trucking waste elsewhere, the diesel emissions of the trucks, impact on roads and dust generation, auto and pedestrian fatalities, etc need to be considered)

• **Multigenerational equity is central.** What happens to the community when the gas runs out?
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**Reasons given by those not in favor of Marcellus Shale drilling**

*(preliminary data)*

Washington, PA public meeting with Natural Gas Subcommittee of the Secretary of Energy Advisory Board, N=59

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<tr>
<th>Reason</th>
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<tr>
<td>Environmental Concerns</td>
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<tr>
<td>Negative Effects on Water</td>
<td>66.1</td>
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<td>Negative Effects on Air</td>
<td>42.4</td>
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<tr>
<td>Chemicals in Water</td>
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<td>General Health Concerns</td>
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<td>Health Problem in Family member attributed to drilling</td>
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<tr>
<td>Personal legal rights have been infringed upon by companies</td>
<td>11.9</td>
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<tr>
<td>Concerns about safety of drilling operations</td>
<td>33.9</td>
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<tr>
<td>Concerns about lack of regulation of industry</td>
<td>42.4</td>
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<tr>
<td>Bias, conflict of interest, or lack of expertise in desired subject area by members of the committee</td>
<td>18.6</td>
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<tr>
<td>Export of domestic natural gas resources</td>
<td>10.2</td>
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<tr>
<td>Depreciation in property values</td>
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“...task the Secretary of Energy Advisory Board (SEAB) with establishing a subcommittee...to develop, within six months, consensus recommended advice to the agencies on practices for shale extraction to ensure the protection of public health and the environment” (emphasis added)

- President Barack Obama

Blueprint for a Secure Energy Future (March 2011)
Language used in Creating Advisory Committees Related to Marcellus Shale Activities

“WHEREAS, the Commonwealth takes seriously its responsibility to ensure the development of natural gas in a manner that protects the environment and safeguards the health and welfare of its citizens” (emphasis added)

Pennsylvania’s Governor Corbett Executive Order (March 2011) establishing the Governor’s Marcellus Shale Advisory Commission
“the following working groups were created to assist the full Commission in its deliberations: Public Health, Safety, and Environmental Protection. [Which is responsible for] consideration of additional measures necessary to ensure the protection of the Commonwealth’s environment and natural resources and the enhancement of public health and safety.”

(emphasis added)

-Excerpt from Governor’s Marcellus Shale Advisory Commission Report
Language used in Creating Advisory Committees Related to Marcellus Shale Activities

“The Marcellus Shale Safe Drilling Initiative will assist State policymakers and regulators in determining how gas production from the Marcellus shale in Maryland can be accomplished without unacceptable risks of adverse impacts to public health, safety, the environment and natural resources” (emphasis added)

-Maryland Governor Martin O’Malley in Executive Order 01.01.2011.11: The Marcellus Shale Safe Drilling Initiative (June 2011)
Committee Composition

Natural Gas Subcommittee of the Secretary of Energy Advisory Board (N=7)

<table>
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<tr>
<th>Government (n=0)</th>
<th>Academia (n=3)</th>
<th>Environmental Groups (n=1)</th>
<th>Civil Society Groups (n=0)</th>
<th>Industry (n=3)</th>
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<tr>
<td></td>
<td>MIT, Professor of Chemistry</td>
<td>Environmental Defense Fund</td>
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<td>Texas A&amp;M, Head of Petroleum Engineering</td>
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<td></td>
<td>Stanford University, Professor of Geophysics</td>
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Committee Composition

MD Marcellus Shale Safe Drilling Initiative Advisory Commission (N=14)

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<td>Nature Conservancy, Maryland Office</td>
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<td>Savage River Watershed Association</td>
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<td>Mid-Atlantic Council of Trout Unlimited</td>
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**PA Governors Marcellus Shale Advisory Commission (N=31)**

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<th>Civil Society Groups (n=5)</th>
<th>Industry (n=11)</th>
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<td>Dept. of Environmental Protection</td>
<td>Penn State University, Professor of Geosciences</td>
<td>Chesapeake Bay Foundation</td>
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<td>Governor’s Energy Executive</td>
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EPA Fracking Research Agenda

“Along with the expansion of [hydraulic fracturing], there have been increasing concerns about its potential impacts on drinking water resources, public health, and environmental impacts...” (emphasis added)

“Future work (over the next 5-10 years) encompassing [air quality, ecosystem, seismic, occupational and economic risks and impacts] should be integrated with the results of current research to provide a holistic view of the impacts of hydraulic fracturing on human health and the environment.” (emphasis added)

-excerpts from the US EPA’s Framework for an EPA Safe and Sustainable Research Program
Possible Reasons for Lack of Inclusion of Public Health Expertise in Governmental Advisory Commissions

• Government fails to recognize that there is a public health risk
Possible Reasons for Lack of Inclusion of Public Health Expertise in Governmental Advisory Commissions

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• There is no relevant governmental or non-governmental public health expertise
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• It is our fault
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