Community Impacts of Natural Gas Development and Human Health

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Workshop on the Health Impact Assessment of New Energy Sources: Shale
Institute of Medicine

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Battlement Mesa HIA
Garfield County, Colorado

200 wells
10 pads
Residential
5000 residents
46 % <18, >65

What possible health impacts?

What can be done to avoid them?
## Battlement Mesa HIA

<table>
<thead>
<tr>
<th>Predicted exposures</th>
<th>Possible Adverse Health Impacts</th>
<th>Recommendations</th>
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</thead>
<tbody>
<tr>
<td><strong>Chemicals</strong></td>
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<tr>
<td>Air (Water)</td>
<td>Physical health</td>
<td>Reduce chemical exposures</td>
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<tr>
<td></td>
<td>Acute, Chronic</td>
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<tr>
<td><strong>NON CHEMICAL STRESSORS</strong></td>
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<tr>
<td><strong>Industrial activities</strong></td>
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<tr>
<td>Noise</td>
<td>Safety risks</td>
<td>Safe industrial operations</td>
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<tr>
<td>Traffic</td>
<td>Traffic accidents</td>
<td></td>
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<td></td>
<td>Fire/ explosion</td>
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<tr>
<td>Industrial malfunctions</td>
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<tr>
<td><strong>Community changes</strong></td>
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<tr>
<td>Quality of life</td>
<td>Psychosocial stress</td>
<td>Multi-stakeholder communication</td>
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<tr>
<td>Property value</td>
<td>Anxiety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insomnia</td>
<td></td>
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<tr>
<td></td>
<td>Lifestyle changes</td>
<td></td>
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</tbody>
</table>
Noise levels (dB)

Drilling

<table>
<thead>
<tr>
<th>Distance (ft)</th>
<th>Noise Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>69/65 dB</td>
</tr>
<tr>
<td>200</td>
<td>83/78 dB</td>
</tr>
<tr>
<td>100</td>
<td>75/70 dB</td>
</tr>
</tbody>
</table>

- 30 dB: Sleep disturbance
- 55 dB: Fatigue, cognition, mood
- 70 dB: School performance

Quiet room: 28-33 dB
Forced air heat: 42-52 dB
Kitchen exhaust fan: 69-71 dB
Garbage disposal: 76-83 dB
Lawn mower: 88-94 dB
Truck traffic

• NY state estimates: 1,000 trucks per well
  – Possibly less if recycling or piping fluids
• Dispersed and well pad impacts
  – Living along haul routes (trucks for more than 1 well/ pad)
  – Round the clock
• Variety of exposures
  – Diesel exhaust
  – Dust
  – Noise, vibration
    • Engine brakes
    • Grinding gears
  – Safety risks
    • School routes
Community changes

• What community changes occur?
• How are they measured?
• How do they impact individual health?
• What about community health?
Community changes
Garfield County, CO  2005-2009

Garfield County population
2000-09: ↑28%
2005-2009: ↑ 14%
Community changes
Garfield County, CO  2005-2009

Police Arrests (number)

Sexually Transmitted Infections (rate)

*Same pattern seem with school enrollment

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Expressions of stress
Garfield County, CO

“I feel angry…impending events weigh on my mind… stress, anger, anxiety, feelings of helplessness and (worry about) possible health problems…”

“There has been be personal distress… including depression, anxiety and insomnia…we don’t know what will happen or when…”
Boomtown Model
Jacquet J, 2009

• Rapid population influx
  – Overwhelm public health, law enforcement, schools

• Unprepared local governments
  – Lack of jurisdiction to control development, land use
  – No mitigation funds

• Old timers vs. Newcomers
  – Resentment about community changes, increased taxes to subsidize new infrastructure
  – Different values/ expectations

• Volatile production patterns
  – Boom/bust cycles unpredictable
  – Financially risky

• Industry monopoly of information
  – Distrust
  – (Power gap)

• Economic impacts
  – Inflation
  – Property values
  – Mixed for old timers, better for newcomers
Social environment and health

- **Social Disorganization** Yen IH, 1999
  - Highly mobile, socially isolated groups unable to develop common values, devolve into social disorganization (measured by TB, suicide, murder, mental illness)

- **Socioeconomic Environment** Lantz PM, 2010
  - Levels of Social Cohesion (shared connectedness, trust, familiarity, values) and Social Capital (resources, benefits of strong social ties that facilitate collective action) are linked to health

- **Neighborhood Impacts** Diez Roux AV, 2001
  - Multilevel analysis can demonstrate that Ecological risk is more than simply the sum of individual risk factors

- **Chemical exposure, Social Stress, Health** Clougherty JE, 2009
  - Allostasis- adaption to stressors that produces “wear and tear on body systems” may enhance susceptibility to chemical exposures via the Hypothalamic-Pituitary-Adrenal axis; and immune system inflammation
Proposed Framework for NGD Impact on Community and Health

NG development → Population Influx → Social Disorganization ↓ Social Cohesion ↓ Social Capital → Psychosocial Stress → Vulnerable individuals

Allostatic changes
Immune System
HPA Axis

Pulmonary
Cardiovascular
Endocrine
Immune
Mental Health

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Overall Framework for Natural Gas Development Impact on Health

NG Development

Chemical Exposures

Psychosocial stress

Community changes

Industrial Exposures

Safety hazards

Vulnerable Individuals

Pulmonary  Cardiovascular  Endocrine  Immune  Mental health  Injuries

Vulnerable Communities

Crime  Traffic Substance abuse  Sexually transmitted infection  Domestic violence  Education

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Opportunities to prevent community impacts and protect public health

1) Rapid population influx
   Address the population influx
   • Controlled/slow development
   • Community planning

2) Unprepared local governments
   Local gov’t resources
   • Jurisdictional control for land use
   • Funds to implement proactive/mitigation measures

3) Industry monopoly of information
   Information Transparency
   • Comprehensive drilling plans
   Residential empowerment
   • Reduce power gap

4) Changing environment
   Monitor impacts
   • Dispersed and pad-side
   • Adaptive management plans
Summary (1)

• Natural gas development can disrupt the social structure of local host communities.
• Social disruption may in turn impact individual health through stress mechanisms, as well as other possible mechanisms.
• A proposed framework for understanding NGD impact on community and health utilizes social epidemiology concepts.
Summary (2)

• Multilevel analytical methods may be employed to determine if and to what degree NGD related social change impacts public health.

• Opportunities to improve health may involve addressing changes to community structures, and allowing for thoughtful planning and mitigation efforts.
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