Fracking and Health: What the Internist Needs to Know

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Overview

- Why the boom in natural gas drilling?
- What is “fracking”?
- Describe Concerns
- Review current state of knowledge re: human health effects
- Environmental health and Exposure studies
- Provide general guidance for evaluating patients with potential exposures & concerns

http://wvsoro.org/

Why the boom?

- Energy independence
- “Greener” than coal or oil
- Economic boost
- New methods allow for accessing previously inaccessible/uneconomical resources

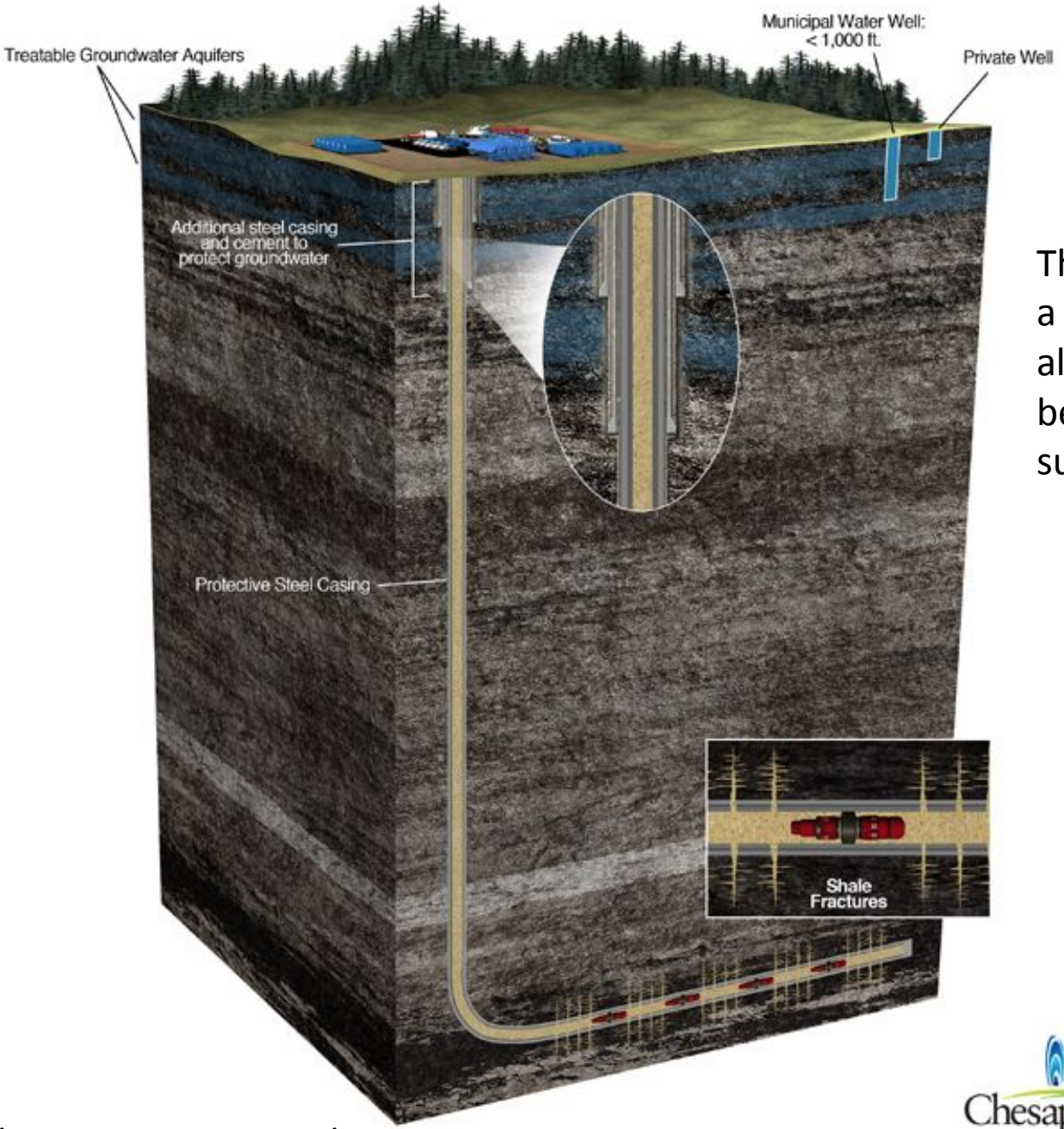
http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

Hydraulic Fracturing, aka “Fracking”

- **Hydraulic fracturing**: Process of creating fissures in underground formations to allow natural gas to flow
  - First use of hydraulic fracturing was in 1947
  - Current fracking technique first used in natural gas shales in the late 1990s in Texas
  - Allows extraction of vast amounts of previously inaccessible hydrocarbons
  - New technique: horizontal drilling
  - Shale gas typically contains over 90% methane

Animation of process

- http://youtu.be/VY34PQUiwOQ



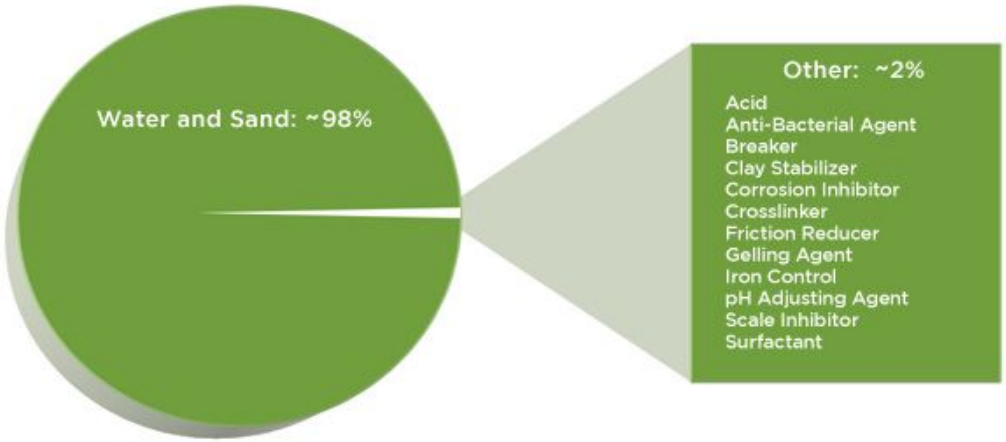
The average depth of a well is almost 1.5 miles below the earth's surface

Chesapeake ENERGY

http://www.youtube.com/watch?v=73mv-Wl5cgg

Materials used

- Base Fluid
  - H20
- Proppant
  - Silica Sand



- Chemical Additives
  - Anti-microbial agents
  - Clay stabilizer
  - Corrosion inhibitor
  - Crosslinker
  - Gelling Agent
  - Iron Control
  - pH Adjusting Agent
  - Surfactant
  - Benzene

- Waste fluid contaminants: *Heavy metals, Radiation, Benzene, Ethylene glycol, etc.*

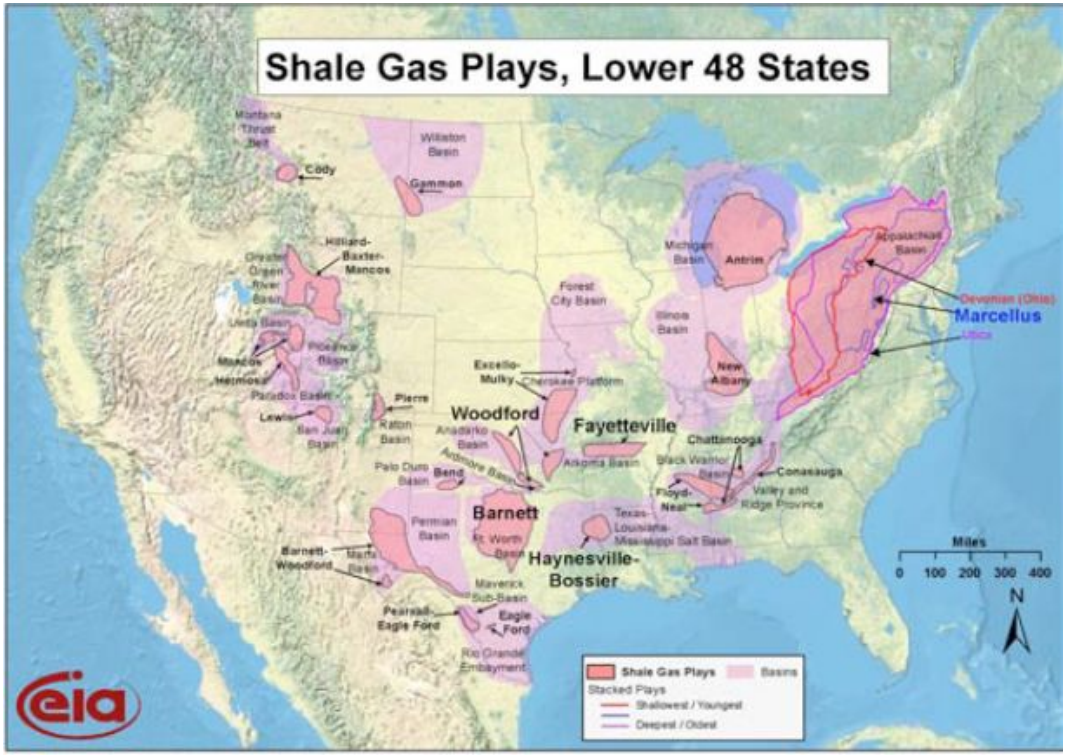
Thompson *Nature* 2012, Schmidt *EHP* 2011

Why the concern that this could be bad?

- Water contamination
- Air contamination
- Earth quakes
- Radiation exposure
- Social disruption
  - Noise
  - Traffic
  - Population influx
  - Proporty devaluation

Who could face risk?

- Workers
- Community residents
- First responders



Documented Human Health Studies

- None
- Anecdotal
  - Dish, TX
    - Blood & urine: toluene
  - Pavillion, WY
  - Colorado RN

http://neinuclearnotes.blogspot.com/2010/08/hydraulic-fracturing.html

Environmental Health = Public Health

- World Health Organization
  - Social determinants of health
    - The social determinants of health are the circumstances in which people are born, grow up, live, work and age, and the systems put in place to deal with illness. These circumstances are in turn shaped by a wider set of forces: economics, social policies, and politics.
- "…it should not be concluded that an absence of data implies that no harm is being done."
  (Finkel and Hays, Public Health, 2013)

http://www.who.int/social_determinants/thecommission/finalreport/key_concepts/en/index.html

Exposure studies pertinent to human health

- NIOSH Silica Evaluations
- NY/PA methane studies
- Colorado School of Public Health VOC study
- Groat University of Texas study
- Colborn & Univ of MO studies on chemicals/endocrine disruptors in water
- EPA

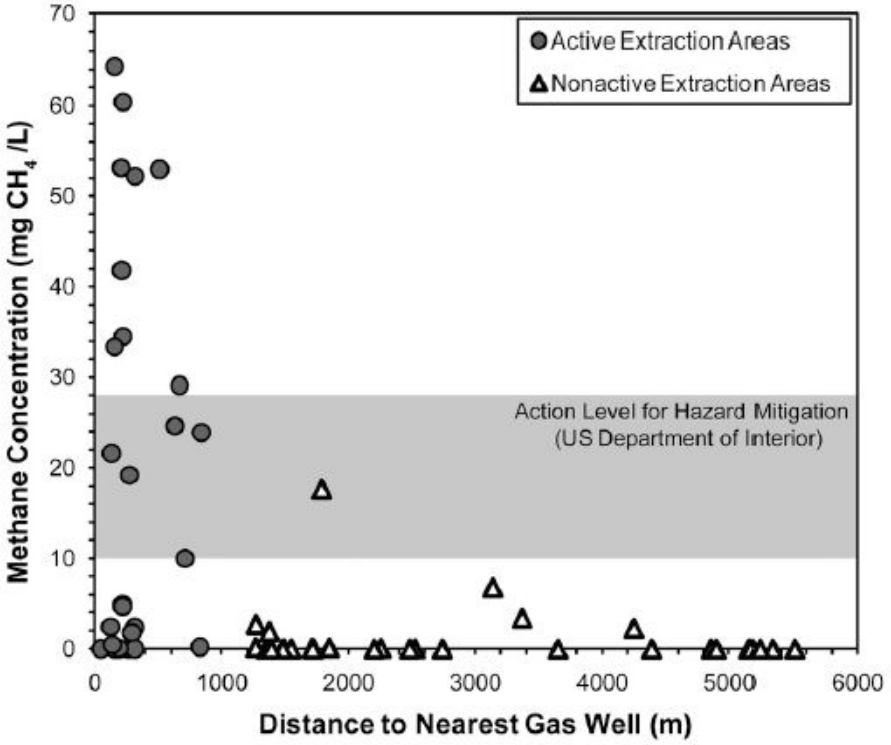
NIOSH Field Effort

- Assessed health risks to oil & gas workers
- Silica air sampling
  - 47% greater than OSHA limit
    - 9% of all samples more than 10x the OSHA limit
  - 79% greater than NIOSH limit
    - 31% of all samples more than 10x the NIOSH limit

Esswein et al, J Occ Env Hyg, 2013

Methane found in well water

- Private drinking water wells in northeast PA & NY:
  - Methane detected in 82% of houses sampled
  - methane concentration ⬆ with proximity to nearest fracking site
  - Carbon dating suggests related to <u>drilling</u>
- No evidence of fracturing fluids



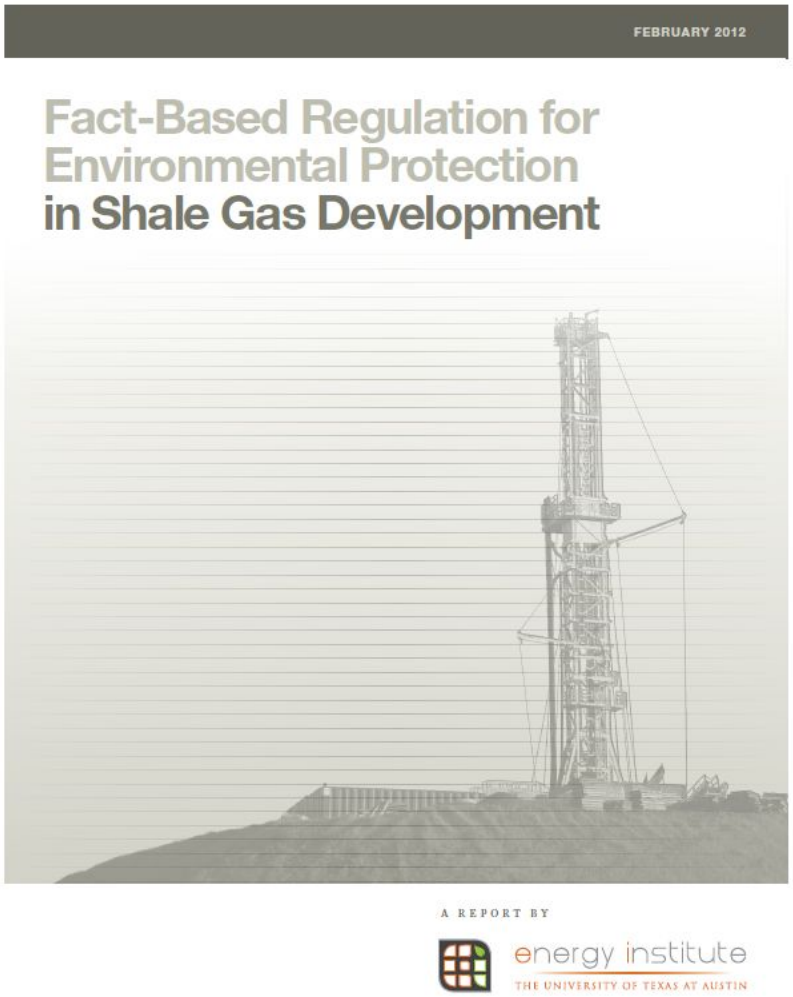
Osborn SG et al. PNAS, 2011
Jackson RB et al. PNAS, 2013.

Colorado School of Public Health study

- Airborne VOCs at levels 5x higher than EPA level if live within ½ mile of drilling site
- Increased Hazard Indices for subchronic non-cancer risks & cumulative cancer risks

McKenzie et al, Science of the Total Environment. 2012

University of Texas Energy Institute Study



- No aquifer contamination from fracking
- No leakage from fracking at depth
- Methane in water wells most likely due to natural sources
- Surface spills of fracking fluids likely pose greater risks to groundwater

Groat & Grimshaw. Fact-Based Regulation for Environmental Protection in Shale Gas Development. 2012; http://energy.utexas.edu/

Colborn 2011 MSDS Review

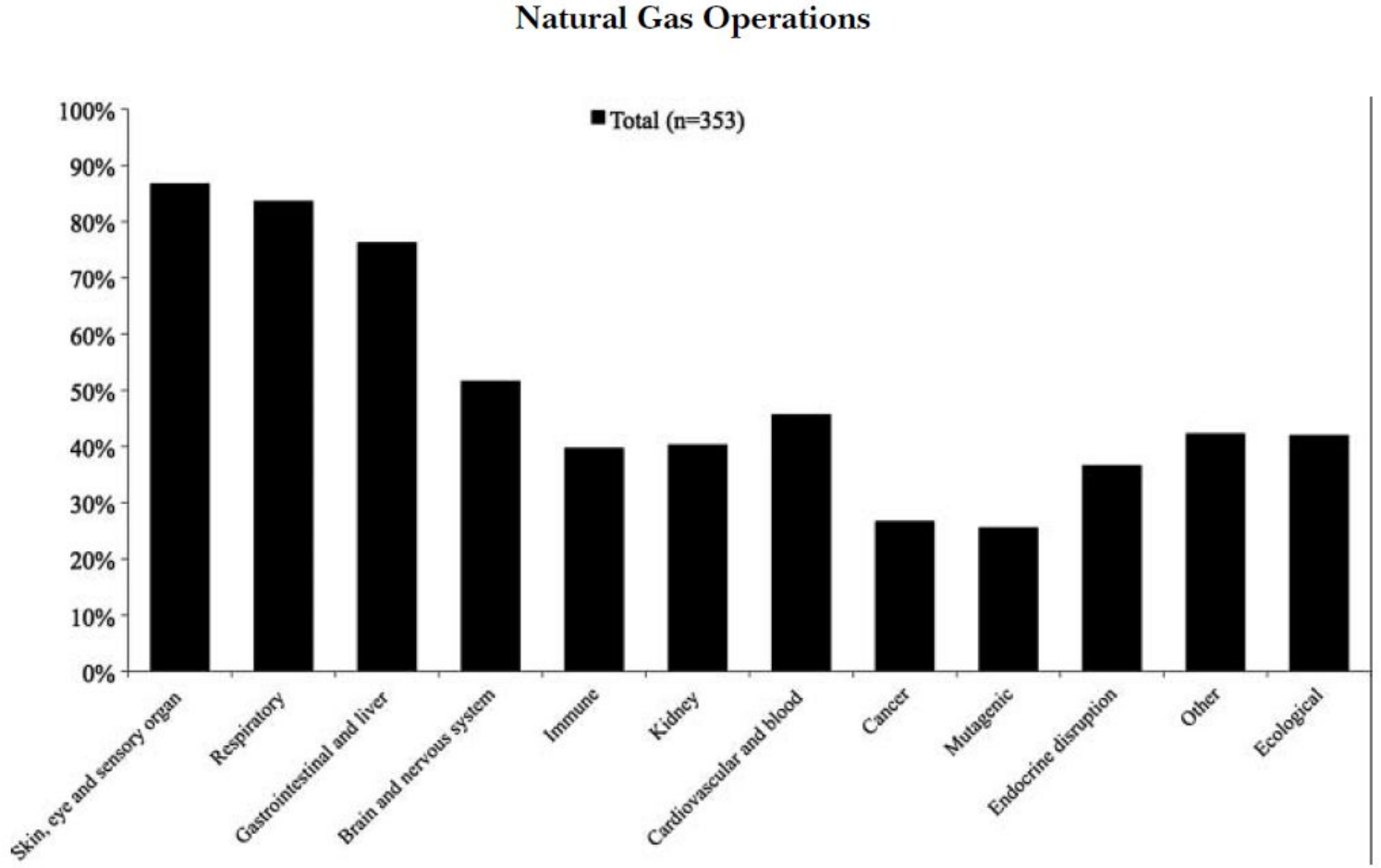
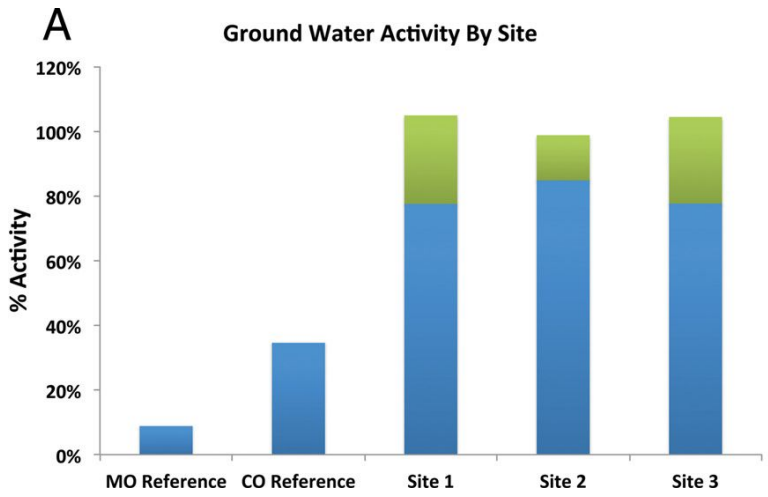


Figure 2. Profile of possible health effects of chemicals with CAS numbers used in natural gas operations.

Colborn et al. Human and Ecological Risk Assessment, 2011.

Endocrine Disruptors in Nearby Water



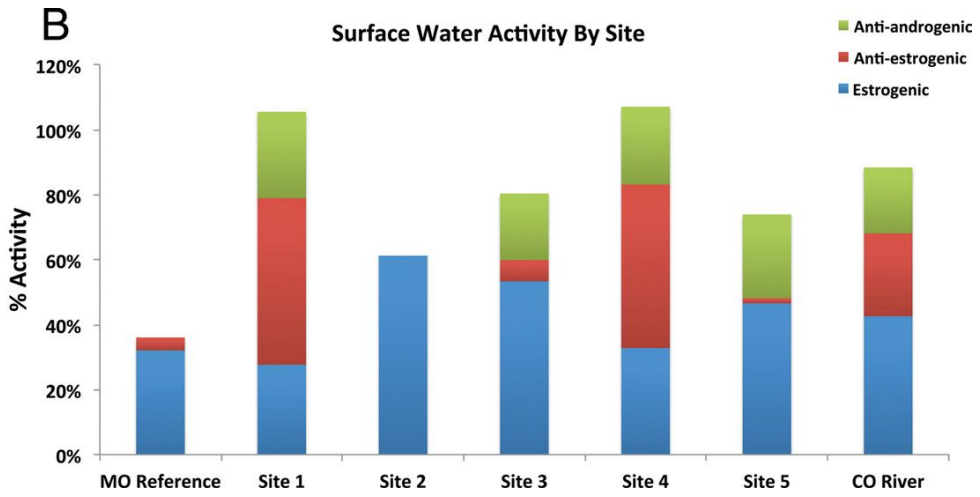


Table 1. Description of Sample Collection Sites

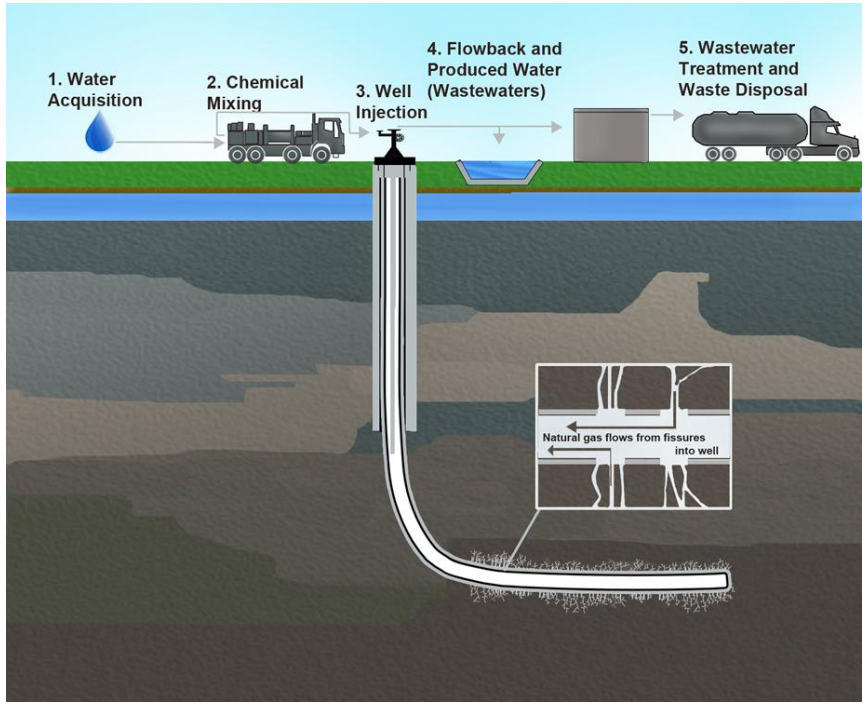
Site Number	Samples Collected (n =)	# NGD wells within 1 mile[1]	Distance to CO River (miles)	Approximate Well Depth (ft)[2]	Approximate Frack Fluid Vol (gal)[2]	Description of Incident	Date of Incident[3]
MO Ref	3	0	N/A	-	-	-	-
CO Ref	2	≈2	4.75–6.5	Unknown	Unknown	-	-
1	8	43	5.25	5,500	4,000,000	Natural gas upwelling	May-08[3]
2	8	78	0.75	8,000	1,500,000	Fluid spill into creek	Dec-09
3	5	69	8.75	9,500	1,000,000	Spill at nearby drill pad	May-08[3]
4	8	136	6.00	9,000	4,000,000	Produced water tank leak	Nov-04
5	9	95	0.50	7,500	3,000,000	Produced water line leak	Jul-10[3]
CO Riv	5	Varied	N/A	-	-	-	-

NGD = natural gas drilling

Kassotis et al, Endocrinology, epub ahead of print, Dec 2013

EPA Environmental Health Study

- 5 States
- H20, Air, Soil testing
- Waste Water
- Analyze well design and construction
- Conduct “toxicity tests”
- Compare pre-drilling to post-drilling



Thompson *Nature* 2012; http://www.epa.gov/hfstudy/index.html

Pavillion, WY EPA Sampling

- Complaints of taste and odor problems from domestic water wells
- Methane found
- Well blowout
- Casings did not extend through areas of accessible water

EPA. Investigation of Ground Water Contamination Near Pavillion, Wyoming, 2011

Fort Worth, TX-EPA drinking water sampling

- 12/7/10 – EPA issued "Imminent and Substantial Endangerment Order" to protect drinking water
  - At least 2 residential wells with extremely high levels of methane
  - Isotopic analysis concludes source from gas production well

http://yosemite.epa.gov/opa/admpress.nsf/e77fdd4f5afd88a3852576b3005a604f/713f73b4bdceb126852577f3002cb6fb!opendocument
Also, AP Photo/LM Otero @

Potential Human Health Hazards

Health Effect	Associated Exposure
• Irritant Effects • Eye irritation, headaches, sore throat, difficulty breathing, nose bleeds	• *VOCs*
• Exacerbation of asthma & COPD	• *VOCs, Ozone, Particulate Matter*
• Silicosis	• *Silica sand*
• Malignancy	• *Benzene*
• Heavy metal poisoning	• *Lead, Uranium, Mercury, etc. – depends on what comes up in the brine*
• Asphyxiation & explosions in confined spaces; Narcosis	• *Methane; Hydrogen sulfide*

Recommendations for Clinicians

- Medical Management
  - Review of symptoms
  - Temporal history of symptoms in setting of exposure
  - Occupational/Environmental History
    - Do they use well water?
    - Neighboring industries?
  - Focus on:
    - Asthma
    - Irritant symptoms
      - ENT
      - Derm
    - Hematologic symptoms/labs
    - Neuro
    - Renal

Recommendations for Clinicians

- Public Health
  - Respirator fit-testing
  - Sentinel case or cluster
    - Report
  - If questions or concerns contact:
    - OSHA (1-800-321-6742)
    - NIOSH (1-888-232-6348)
    - EPA
      - National Response Center at 1-800-424-8802.

How can exposures be controlled and health risks minimized?

- Occupational
  - Elimination/substituion
    - Use silica substitute
  - Engineering controls
  - Administrative controls
  - Personal Protective Equipment
    - NIOSH-approved Fit-tested Respirator
- Community
  - Increase distance from well sites

- SAFE WELL CONSTRUCTION
- WASTE WATER MANAGEMENT

EPA Green Completions

- Purpose is to reduce VOCs (that combine with other agents, generate NOx, smog, ozone, etc) associated with NGD
  - Phase 1 – Flare
  - Phase 2 – Capture gas and make available for use or sale

http://www.epa.gov/airquality/oilandgas/pdfs/20120417changes.pdf

http://www.texassharon.com/2011/01/01/barnett-shale-who-decides-who-suffers/

What regulation exists for these processes or chemicals?

- OSHA Standards
  - *Nothing specific to fracturing fluids*

- EPA
  - Air: 2012 regulations
    - VOCs
    - Methane
    - Air Toxics
  - Water
    - Exempt from Safe Drinking Water Act

Fracking in Maryland

- Moratorium until data gathered
  - Expected Summer 2014
  - Activists want another 18 months of bar
  - Supporters warn that Maryland may miss out

Baltimore Sun, 1/8/14

Conclusions: Fracking & Human Health

- Fracking to uncover natural gas stores is an expanding industry across the country
- Many incompletely understood potential risks to workers and the surrounding community
- Lack of transparency heightens public concern
- Need for further investigation

FRACKING and the CLINIC

- New technology creates opportunities for new, and new ways to get old, occupational & environmental illness
- Internists
  - Be knowledgeable about potential risks
  - Take the Occupational & Environmental History
    - Ask about well water
  - Characterize symptoms based on known and theoretical possibilities for disease
  - Sentinel case/cluster identification

Further resources

- http://news.nationalgeographic.com/news/2010/10/101022-breaking-fuel-from-the-rock/
- https://www.osha.gov/SLTC/etools/oilandgas/index.html
- Acknowledgments
  - Fred Beach, PhD
  - Assistant Director for Policy Studies, The University of Texas at Austin Energy Institute