Hydraulic Fracturing

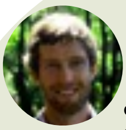
Physicians for Social Responsibility

Public Health Concerns of Shale Gas Development

Jake Hays & Adam Law, MD (Excerpted)

Natural gas has recently come to the forefront of the world's energy discussion. Hydraulic fracturing, used in combination with other recent key technologies, has enabled gas extraction from geologic formations of low permeability (e.g. shale) that were previously too expensive to exploit. Due largely to its abundance, shale gas has been viewed both as a transition fuel and as a way for the United States to become independent from foreign oil.

This modern form of hydraulic fracturing (hereafter referred to as HVHF *high-volume, horizontal fracturing*) differs from previous forms in both technique and magnitude, carrying with it a host of new public health and environmental concerns. Public health concerns about HVHF focus primarily on pollutant exposure from air emissions and water contamination; however, the entire life-cycle of unconventional shale gas extraction is potentially polluting. This includes everything from clearing the land for the gas well pad, to initial hydraulic fracturing, subsequent recompletions, and the final capping of the well years or decades later after it is no longer productive.



Jake Hays

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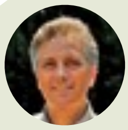
The hydraulic fracturing of shale occurs deep underground. Although there are some legitimate concerns that this may cause direct problems through the propagation of cracks, events closer to the surface provide clearly demonstrated pathways of exposure. Water contamination can occur in a variety of circumstances, such as transportation spills of fluids and produced waters; well casing leaks; leaks through fractured rock; drilling site discharge; and wastewater disposal[1].

Drilling chemicals and fracturing fluids used in various steps of the drilling process can be highly toxic and include known carcinogens (e.g. benzene, butoxyethanol, boric acid, methanol). Endocrine-disrupting chemicals are also present in significant amounts; they interfere with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body which account for homeostasis, reproduction, development and/or behavior.[2]



Adam Law, MD PhD

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"Flowback water" withdrawn from the well after the fracturing process, and "produced water" returned to the surface with the natural gas, introduce other toxic substances. In addition to the toxins put into the ground, these returned waters contain heavy metals (e.g. lead, arsenic), naturally occurring radioactive materials (e.g. radon, uranium, chromium), bromide, and chloride (brine). Containment of these returned waters remains a problem and recycling (i.e. reuse for other drilling operations) accounts for only a portion of these toxic fluids. Flowback and produced waters are often put in evaporation ponds, which have been known to leak, contaminating water and soil and leading to documented instances of fish and livestock deaths.[3] Much waste has been brought to municipal sewage treatment plants, which are not designed to handle these types of toxins. No suitable or concrete plans have been made for the treatment and storage of wastewater from shale gas extraction in the Marcellus Shale region.

In addition to chemical contamination, methane, the principle constituent of natural gas, has been found in aquifers at concentrations well above hazardous levels. A Duke University study in Pennsylvania that tested sixty-eight water wells found that groundwater near drilling areas contained methane concentrations seventeen times higher than wells where drilling was not taking place.[4] Methane is also emitted into the atmosphere by leaking and venting throughout various stages of natural gas production, processing, transmission, and distribution. Methane is a potent greenhouse gas, and while it doesn't stay in the atmosphere as long as carbon dioxide, it is 105X and 33X as strong as CO_2 over 20-year and 100-year timeframes, respectively.[5] A field study air sampling in the Denver-Julesburg Basin of Colorado suggest natural-gas producers are losing about 4% of their gas to the atmosphere.[6] In the atmosphere, methane contributes to global climate change, which in turn affects human health in a number of ways, including heat waves, extreme weather events, flooding, water contamination, sea level rise, expansion of insect ranges and populations, worsening air quality, crop damage, and social instability and conflict.

The fugitive emissions of natural gas production matter significantly in the context of climate change and also have other implications for public health. Methane atmospherically transforms to toxic ground-level ozone when it interacts with sunlight. Methane and other ozone precursor emissions such as nitrogen oxides, and volatile organic compounds (VOCs) can lead to increased respiratory morbidity and mortality.[7] [8] Natural gas operations also produce other conventional air pollutants such as benzene, xylene (BTEX), formaldehyde, toluene, hydrogen sulfide, and ethylbenzene that pose both carcinogenic and non-carcinogenic health risks. A recent health risk assessment of air emissions showed that residents living a half-mile or less from gas wells are at a greater risk for health effects than those living more than a half-mile away. The study found subchronic exposures to air pollutants during well completions to pose the greatest risk, with benzene being the major contributor to cumulative cancer risks.[9]

Significant air pollution emissions come not only from natural gas drilling and processing operations, but from transportation as well. Each hydraulic fracturing event requires on average an estimated 5 million gallons of water in addition to large quantities of proppants (silica, quartz sand) and chemicals. Based on fluid transportation and other well pad activities (e.g. construction, equipment), a total of 3,950 heavy and light-duty truck trips are required for each horizontal well,[10] given that each well can be hydraulically fracked multiple times during its productive life. Fine diesel particulate matter as well as nitrogen oxides and VOCs are emitted into the atmosphere during transportation, posing additional concerns for public health.

The recent boom in shale gas production has left the public health community scrambling to catch up. There is a current paucity of scientific information on the health effects of HVHF and many barriers stand in the way of creating solid epidemiologic studies. For one, data collection and analysis have been hampered by regulatory exemptions at the federal level. The 2005 Energy Policy Act exempted the natural gas industry from seven major federal laws designed to protect public health, including the Safe Drinking Water Act and the Clean Air Act. The United States Environmental Protection Agency (EPA) still does not regulate the injection of fracturing fluids and the industry is not required to disclose chemicals it considers to be proprietary. At the local level, the signing of non-disclosure agreements by landowners when drilling companies settle and pay for illnesses suffered and contamination also obstructs the availability of necessary data. In addition, questions regarding the level, length, and source of exposure are difficult to answer in the context of natural gas operations. This makes it hard to link contamination incidents to drilling activities, creating a significant hurdle for scientific research. Furthermore, the toxicological complexity of the chemicals used in natural gas operations creates problems for causal inference.

While no energy production method is completely benign, the large-scale development of shale gas resources and their potential impacts on human health and world climate call for the utmost precaution. Thus, the continuation of current moratoria and bans is prudent until the appropriate science documents HVHF's effects on public health. Potential exposure pathways must be further investigated, and epidemiologic research is needed to quantify short-term and long-term risks to human populations. Only then will policy makers have the necessary information to conduct an appropriate cost-benefit analysis or Health Impact Assessment. And only then will our nation be able to design a policy for shale gas extraction that adequately balances energy development with protection of human health.

For more information, please visit http://www.psr.org/environment-and-health/environmental-health-policy-institute/

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