Fracking: The Harms and Risks to Health

"…a significant body of evidence has emerged to demonstrate that these activities [fracking] are inherently dangerous to people and their communities."[1]

Health is no longer considered to be simply the absence of disease. Since the 1950s the World Health Organisation has been defining health in much broader terms, recognising the many factors that influence our overall health. It is now accepted that the health and wellbeing of an individual or a community is determined by several interacting factors. These factors include; economic circumstances, the physical and social environment, psychological, behavioural and biological factors.

All of these factors are affected by the political, cultural, social and environmental contexts in which they sit. So, influences as diverse as; agriculture and food production, education, the work environment, living and working conditions, unemployment, water and sanitation, health care and social services, the political environment and governmental strategies and policies, all play their part in affecting our overall health. Current evidence is making clear that the fracking industry's influence can extend into every single one of these areas (see the end of this section for an example).

In December 2014, with specific regard to unconventional shale gas exploration and extraction (UGEE, which includes fracking), Concerned Heath Professionals of New York (CHPNY) published the 2nd edition of the Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking[1]. For some time, the industry had exploited the newness of their method of fracking to deflect any questions about the health impacts, on the grounds that there is no supporting evidence. This compendium extensively documents significant and numerous impacts under each of the following headings:

1. Air pollution
2. Water contamination
3. Inherent engineering problems that worsen with time
4. Radioactive releases
5. Occupational health and safety hazards
6. Noise pollution, light pollution and stress
7. Earthquakes and seismic activity
8. Abandoned and active oil and natural gas wells (as pathways for gas and fluid migration)
9. Flood risks
10. Threats to agriculture and soil quality

---

1. The Concerned Health Professionals of New York Compendium (December 2014) http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf

INFORMATION ON THE HEALTH IMPACTS OF FRACKING

There is now such a wealth of information on the adverse health impacts of fracking (and it continues to increase) that we need to manage it, so that it makes sense to us. Dr Roxana Witter organised this very well in her webinar in April of 2012[2]. Dr Witter was the lead researcher in the Health impact assessment for Battlement Mesa[3] also known as the Colorado Report. In that report, Dr Witter refers to much of the evidence that is now included in the CHPNY Compendium[1]. She and her team were researching the impacts of the natural gas development (NGD) industry on this community. In a very interesting article the following year[4], Dr Witter outlined the political influences on their study, which illustrates the reach of the industry, and pro-industry parties, into what should be independent research.

The following information is quite detailed, in an effort to answer any questions the reader might have. If you prefer to read something shorter, the executive summary of the CHPNY Compendium[1] is very readable and informative.

THE HEALTH HAZARDS AND IMPACTS OF FRACKING[2]

The following information is largely from Dr Roxana Witter's webinar 9.4.12 (available on https://www.youtube.com/watch?v=xLiG8P9fy1I). Other sources are indicated in the text. Some further principles and issues involved in looking at the Health impacts of Fracking are outlined at the end of this section.

WHO WILL BE AFFECTED?

1. **Local populations** - those close to the action, who face exposure to chemicals, noise, safety risks, community and psychosocial effects

2. **Occupational populations** - face the same risks as the local population

3. **Regional populations** - the air shed is impacted by pollutants and ozone development.

4. **Global populations** - methane, greenhouse gas formation and community impact.

In all of the above populations we have to consider vulnerable subpopulations. These are; children, the unborn, the elderly, those with chronic disease and the poor.

---

2. Dr Roxana Witter's webinar 9.4.12 https://www.youtube.com/watch?v=xLiG8P9fy1I
3. Witter, R., McKenzie, L., Towle, M., Stinson, K., Scott, K., Newman, L., & Adgate, J. (2010). *Health impact assessment for Battlement Mesa, Garfield County Colorado*. Colorado School of Public Health. Available from http://www.garfield-county.com/public-health/documents/1%20%20%20Complete%20HIA%20without%20Appendix%20D.pdf
4. Witter, R., McKenzie, L., Stinson, K.E., Scott, K., Newman, L.S. and Adgate, J. (2013) *The Use of Health Impact Assessment for a Community Undergoing Natural Gas Development.* American Journal of Public Health. Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3698738/

1. Impact on local populations (who face industrial hazards)

a) CHEMICAL STRESSORS - air / water / soil contamination and
b) NON CHEMICAL STRESSORS – noise, industrial accidents, truck traffic, accidents and community effects.

A) CHEMICAL STRESSORS.

Air pollution - every well is a source of air pollution. **Every stage of natural gas development produces air pollutants. This happens under normal operations, not only when accidents occur.** Low level emissions can occur for the duration of production. Bolus emissions can occur during development and chronic emissions can go on for 30 years. If there are 1000 wells in a region, this has to be considered from a Public Health point of view.

There is some documentation of air pollution, but not a lot of studies yet. In Colorado it has been shown that volatile organic compound (VOC) exposure risk is higher for those living near the wells than those living further away.

In Wyoming, winter time ozone levels have been measured at 125 parts per billion. The EPA standard is 75 parts per billion. Similar increases have been seen in Utah, South Colorado and New Mexico. VOCs and nitrogen oxide are precursors to ozone, in rural areas - really the only source of these is the natural gas industry. Ozone modelling in Texas and Louisiana shows that summertime ozone levels could increase by 5 parts per billion or more, from the shale gas development there. A study from the National Oceanic and Atmospheric Administration in Boulder, Colorado shows that methane and VOC levels are likely to be underestimated from natural gas development sites.

Research published in May 2014 has found that measured methane leaks from fracking operations were three times larger than forecasted. The US Environment Protection Agency therefore "significantly underestimates" methane emissions from fracking, by as much as a 100 to a 1,000 times according to a new Proceedings of the National Academy of Sciences study published in April.

The Associated Press also reported, citing a Government Accountability Office investigation that the US Interior Department's Bureau of Land Management had failed to adequately inspect thousands of oil and gas wells that are potentially high risk for water and environmental damage. http://www.theguardian.com/environment/earth-insight/2014/may/22/two-thirds-write-down-us-shale-oil-gas-explodes-fracking-myth

Greenhouse gas footprints from the unconventional sources versus conventional sources predict unconventional energy greenhouse gas sources will be higher; this is probably due to the bolus emissions during the development.

Polycyclic Aromatic Hydrocarbons (PAHs), are released from flaring and are found in exhaust fumes form petrol and diesel engines. The atmospheric concentration of highly carcinogenic polycyclic aromatic hydrocarbons (PAHs) measured across an unconventional natural gas patch in Colorado (taken to represent a typical shale gas field) was 15.5 ng/m3 - 60 times

that allowed in UK. (FFBRA, Impacts of Shale Gas Extraction draft consultation document, 2013)

Water contamination – Emerging science confirms that drilling and fracking inherently threaten groundwater. In Pennsylvania alone, more than 240 private drinking water wells have been contaminated or have dried up as the result of drilling and fracking operations over a seven-year period. A range of studies from across the United States presents strong evidence that groundwater contamination occurs and is more likely to occur close to drilling sites. The nation's 172,000 injection wells for disposal of fracking waste also pose demonstrable threats to the drinking water aquifers. Disposal of fracking waste in sewage treatment plants can encourage the formation of carcinogenic by products during chlorination. Overall, the number of well blowouts, spills and cases of surface water contamination has steadily grown. Meanwhile, the gas industry's use of "gag orders," non-disclosure agreements and settlements impede scientific study and stifle public awareness of the extent of these problems[1].

In the West (USA), the waste water can be disposed of in deep injection wells, which are monitored by the EPA, or by evaporation leaving contaminated sludge behind.

In the East waste water can be disposed of in municipal water treatment plants, which are not very well equipped for this and there is some evidence that downstream water is contaminated which chemicals from the development process.

In Pennsylvania methane contamination of drinking water showed more in natural gas development areas than non-natural gas development areas. A primary health hazard is methane migration from active drilling sites to aquifers. In Pennsylvania, Osborn and colleagues found that the average methane level was 17 times higher in private drinking-water wells within one kilometre, or about 3,280 feet, of active drilling sites, compared with those in non-drilling areas. (McDermott-Levy, R., Kaktins, N. and Sattler, B. (2013) Fracking, the Environment, and Health New energy practices may threaten public health. AJN Vol. 113, No. 6). Groundwater was contaminated by organic and non-organic compounds, which was consistent with migration from natural gas development sites. This study was done in Wyoming by the EPA.

Faulty casing and poor well installation is associated with methane, benzene and chloride in drinking and surface water in Garfield County. Radium 226 was found Marcellus shale waste water in New York.

Threats to agriculture and soil quality – Drilling and fracking pose risks to the agricultural industry. In California, fracking wastewater illegally dumped into aquifers has threatened crucial irrigation supplies to farmers in a time of severe drought. Studies and case reports from across the country have highlighted instances of deaths, neurological disorders, aborted pregnancies, and stillbirths in cattle and goats associated with livestock coming into contact with wastewater. Potential water and air contamination puts soil quality as well as livestock health at risk. Additionally, farmers have expressed concern that nearby fracking operations can hurt the perception of agricultural quality and nullify value-added organic certification[1].

Solid waste (the contaminated sludge left behind after evaporation of the waste water) requires more research (Bamberger and Oswald, 2012).

Soil and Oil Spill Contamination:
http://serc.carleton.edu/NAGTWorkshops/health/case_studies/hydrofracking_w.html

Chemicals in the air and water?
How much is being emitted? And are people in contact enough with contaminated air and water to get health effects? If exposure is sufficient, these chemicals do cause health effects.

BTEX chemicals (benzene, toluene, ethylbenzene and xylenes), these compounds are some of the volatile organic compounds (VOCs) found in petroleum derivatives. They have harmful effects on the central nervous system, causing headaches, nerve damage, birth defects and leukaemia.

Nitrogen oxide, sulphur dioxide and particulate matter (criteria pollutants) cause a variety of health effects. Diesel exhaust fumes (coming from the generators) are associated with a variety of health effects.
http://www.epa.gov/airquality/ozonepollution/health.html
http://www.epa.gov/airquality/particlepollution/health.html
http://www.epa.gov/airquality/nitrogenoxides/health.html
http://www.epa.gov/airquality/sulfurdioxide/health.html

Fracking chemicals; we don't know what is being used and we don't know a lot about how much is getting in contact with people. It is hard to predict what the health effects would be. We do know that some of the chemicals can cause health effects.

B) NON-CHEMICAL STRESSORS

Noise, traffic, changes in the population, concern about decreasing property values, these are the community impacts.

Noise; produced during drilling and fracking processes. One person reported that flaring sounds like an airplane. Truck traffic is also loud. 1 test showed that at 1000 feet away from the well, the noise of the compressor was still measuring at 69 decibels.

Truck traffic; how many trucks are necessary? About 1000 trucks per well. It can be more or less; if recycling is used for the water, it could be less. Or if they are piping in water, instead of trucking it, is this could reduce this to the hundreds, but this is still a lot.

The Pennsylvania Sheriff's Department, in an NGD area, looked at trucks hauling water and waste or drilling and development support materials over a 3-day time period. They stopped 1100 trucks; 959 safety violations were discovered. 140 trucks and 64 drivers were taken out of service due to the severity of the violations uncovered in this exercise.

Population changes; the population that comes in with the industry is usually made up of young men, they are well paid and they are transient. They have specific jobs; they may be involved in the actual fracking, or drilling or pipe laying on the well pad. They might come for two weeks, work on their specific job and move on. Some brought young families.

In Garfield County, the population increased by 28% over the course the decade. Police arrests increased, in the middle of the natural gas development area. School enrolment increased and then dropped. Teachers reported a large turnover in the students, children would be there for a few months at a time. There was an increase in sexually transmitted infections - these are all the ecological effects.

Property values if drilling occurs on or near a person's property, property values are likely to suffer. Reports from Garfield County in 2006, show properties lost value. The loss was due to quality of life impacts; increased truck traffic; increased odours, increased dust and noise. This made the property less appealing. There was also institutional uncertainty; loan agencies and insurance agencies were not as excited about lending or covering these types of properties. The perception of increased risks due to being close to the well, and that 1 well, more often than not, meant more wells in the future. If the well was completed during the sale, then this had the worst impact on their price. But in any case, wells decreased the value of a house.

Psychological or psychosocial impact;
Anger, stress, helplessness, worries about health, depression, anxiety and insomnia.
How do all these fit in with physical health? Well increased truck traffic leads to increased risk of injury and death, severe injuries or fatalities. Increased noise affects sleep, mood, fatigue and school performance. Population changes give rise to psychosocial stress and property value worries interfere with sleep and feelings of safety. Psychosocial stress has an impact on blood pressure changes and cardiac disease is impacted by psychosocial stress.

2. Impact on local communities (NGD workers);
Similar *chemical, physical and social exposures* exist for workers in the NGD industry.
Also, the National Institute for Occupational Safety and Health (NIOSH), a federal agency in Worker Health studied the effects of silica and natural gas. Sand is used in the process of fracking. Silica dust escapes when sand is dumped into the hoppers prior to injection into the well. Eric Esswein's study showed silica in the air was high enough to be of concern, it is a cause of *silicosis*, and this is an occupational hazard.
(http://www.iom.edu/Activities/Environment/EnvironmentalHealthRT/2012-APR-30/Day-1/Session-3/1-Esswein.aspx)

Pipe dope, (a specially formulated blend of lubricating grease and fine metallic particles that prevents thread galling (a particular form of metal-to-metal damage) and seals the roots or void spaces of threads) used to lubricate the drill, contains up to 50 per cent *lead*. The workers get covered in this and in one documented case, children with very high levels of lead in their blood were seen - the health agencies followed the link back to the natural gas development workers bringing lead home on their work clothes.
http://www.epa.gov/airquality/lead/health.html

The industry is also very dangerous; there are *high injury and fatality rates*. In Wyoming, there are high rates of traffic fatalities in gas development industry. According to the United Nations Environment Programme Report, when occurring in densely populated areas, UG production raises several specific threats to well-being. The most direct concern is the risk of explosion from the construction of new pipelines (Rahm D (2011). Regulating hydraulic fracturing in shale gas plays: The case of Texas, Energy Policy, 39, 2974 -2981).

It's a *noisy* industry also – which can have health effects.

The social impact; a large influx of workers where there is inadequate housing can lead to problems. The man-camps set up for transient workers caused concern about the drug and alcohol use in these camps. There is a documented increase in sexually transmitted infections in the natural gas development worker population in Canada.

3. Impact on Regional populations

Areas of Colorado have been out of compliance regarding ozone for the last couple of years. Wells County is a large producer of nitrogen oxide and the VOCs when these combine in direct sunlight it creates ozone. The national gas industry is a primary source of VOCs and nitrogen oxide. Regionally, an increase in ozone increases the risk of cardiovascular disease, arrhythmias, hypertension, asthma, COPD exacerbation and adverse birth outcomes.

4. Impact on Global populations

Natural gas is more than 90% methane; we are bringing this up out of the ground and putting it into the atmosphere. Methane is a stronger greenhouse gas than carbon dioxide and there are lots of potential methane emission points, during; well development, gas compression, gas refining, pipeline maintenance, pipeline transmission and end-use inefficiencies. The amount of the loss is being disputed, but it is clear that some methane is being lost into the atmosphere. Losses are greater than currently estimated.

****

Further points for consideration

The question of how natural gas development impacts on public health is actually a series of questions;

1. How does the combination of multiple chemical and non-chemical stressors impact on local, regional, occupational and global populations?
2. How do these combinations of stressors impact rural and urban populations?
3. What about the susceptible subpopulations?
4. Is there an environmental justice component?
5. What policies are needed?

Finally, further independent research is needed on;

- The risk of birth defects related to distance from wells
- Occupational exposures
- Regional ozone
- Local chemical exposure and non-chemical exposures

Principles and issues involved in looking at the Health impacts of Fracking

1. The precautionary principle must be applied in all decisions about the safety of fracking with regard to human and animal health.
2. There are no long term studies on the health effects of fracking completed yet, so we don't know what the effects are.
3. Low risk does not mean safe.
4. Mitigation of health effects by regulation does not work.
5. Chemical exposure is usually measured singly; it is not known how exposure to the interactions of several chemicals would affect people.
6. We do not have enough evidence of the effects of long-term, low-level exposure to chemicals associated with fracking.
7. Nondisclosure agreements are common in all areas of business and are often essential to protect intellectual property. However, when documentation of health problems associated with gas operations is shielded from public scrutiny by a nondisclosure agreement, this is clearly a misuse of this important business tool and should be prohibited (Bamberger and Oswald, 2012).

An example of the use of the law regarding health impacts and fracking in the USA.

1. Communities and health care providers have had limited access to information about the chemicals used in the hydraulic fracturing process, as well as limits placed on their ability to inform and share information about chemical exposures. For example, ***Pennsylvania's Act 13 of 2012 states that drilling companies are not required to share information about the components or concentration of chemicals*** if these are deemed proprietary trade secrets.33 ***This act also requires that health professionals*** submit a written request for information on proprietary solutions used in fracking and ***sign a "confidentiality agreement"*** identifying that the information is needed to diagnose or treat an individual.
2. ***Pennsylvania law states that health care professionals are not permitted to share exposure information.*** This hinders the development of effective, evidence-based assessment and treatment practices related to the health effects of these chemicals on exposed patients. (McDermott-Levy, R., Kaktins, N. and Sattler, B. (2013) Fracking, the Environment, and Health New energy practices may threaten public health. AJN Vol. 113, No. 6)

Further reading

A Public Health Review of High Volume Hydraulic Fracturing for shale Gas Development. New York State Department of Health
https://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

Physicians, Scientists and Engineers study citation database
http://www.psehealthyenergy.org/site/view/1180

McCoy, D. and Saunders, P. (2015) *Health and Fracking; The impacts & opportunity costs* MEDACT Available from http://www.medact.org/wp-content/uploads/2015/03/medact_fracking-report_WEB3.pdf

Lightowlers, P. (2015) *Chemical pollution from fracking* CHEM Trust Available from http://www.chemtrust.org.uk/wp-content/uploads/chemtrust-chemical-pollution-from-fracking-june2015.pdf