



Health Effects that May Result From Fracking

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Introduction

The health impact that hydraulic fracking may have on humans is important for the fracking situation because health is usually individuals' biggest concern. Health is something that impacts individuals directly in an uncontrollable way. If individuals did not feel that they are putting their health at risk, then the fracking situation would gain more support from the community. However, if it is proven that fracking causes serious negative health effects, then the entire fracking situation could be halted.

The connection between fracking and its possible health impacts stirs up some controversy. The uncertainty of this relationship makes individuals feel uncomfortable and not supportive of this industry. Exposure to fracking chemicals is not strictly regulated, making individuals skeptical about the situation. The fracking chemicals used are known to pose a threat to human health, so it's a controversy why they are allowed.

The health concern that arises from the fracking situation is important for the general public because public health may be at risk. Large-scale studies about this matter have not been done to help the public's health knowledge on this issue.

Having knowledge about this issue is not only valuable to those who live in a close proximity to fracking sites, but it is also important for other members in our society—the workers at these fracking sites, for public health organizations, health care professionals, and many more.

Topic Discussion

The following report will cover the uncertainty of health effects caused from fracking, the chemicals involved in this process that cause health problems, reported health concerns that may result from fracking, the exposure pathways of these fracking chemicals, and an analysis of human health issue from case studies of where fracking has already occurred.

Uncertainty

One of the main problems when determining whether there is a direct connection between fracking and human health is the uncertainty of the issue. It is difficult to prove that fracking is the main cause of various health effects because there was no formal data gathering on the health of individuals who live in a close proximity to fracking sites before the act of fracking occurred (Brown et al., 2012). Since there are no baseline data on humans' health to refer to, there is no actual proof that humans' health has changed because of fracking. Fracking of the Marcellus Shale, specifically, has only been in effect for a few years. A sufficient amount of time has not passed for studies regarding natural gas production and its health impacts to be completed (Button, 2010).

One reason why long-term studies have not been conducted is due to the lack of cooperation from drilling companies. Drillers have declined to cooperate in studies involving the investigation of health effects of drilling in areas where citizens have expressed illnesses from fracking (Lustgarten&Kusnetz, 2011). Not only does this add to the uncertainty of the health effects from fracking, but also it is worrisome that these companies are not confident enough to partake in these studies.

It is difficult to retrieve and collect completely accurate data about the possible health effects and pollutants emitted from fracking may cause, even if drilling companies participated. For example, it is extremely difficult and unrealistic to constantly monitor the air quality in all places where people feel that they are at risk from fracking pollutants. There may also be the incident that some air quality detectors pick up emissions from a different source other than a specific fracking site. It is also difficult to indicate what the peak amount of exposure of a contaminant is when random sampling is performed, when sampling is done for only a short period of time (U.S. Department of Health and Human Services 2010, 5). When analyzing a health report, it is important to notice the parameters of what was done. With the lack of data collected and medical evaluations of individuals, it has been difficult to prove a connection between health effects and fracking.

The lack of regulation regarding Marcellus Shale adds to the issue of uncertainty. It is a major problem that gas exploration and production activities are exempted from six federal regulatory acts that were originally created to protect public health: the Clean Air Act, Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act, and Emergency Planning and Community Right to Know Act (Witter et al., 2008, 5). During an assessment by the Environmental Protection Agency (EPA), in 2010, that tested the drinking waters near Marcellus Shale in Pennsylvania, it was concluded that the chemicals used in fracking that were detected did not have a high enough concentration in the drinking water to be of a health concern to individuals (Button, 2010). However, diesel fuel was the EPA's largest concern regarding its use within fracking fluids because of its potential health effects. Diesel is made up of specific carcinogens that are regulated under the Safe Drinking Water Act (Button, 2010). These

carcinogenic chemicals that make up diesel are also the only compounds out of the many fracking fluids used that are regulated under this act. The use of these chemicals causes a lot of controversy over the uncertainty of the health issues that may exist from fracking.

Fracking Chemicals that Cause Health Problems

As mentioned before, companies are required to report the names of chemicals and gases used in fracking. It has been reported that 37% of chemicals used in the extraction and refining of natural gas can volatilize (Garrison et al. 2011, 676). Volatile substances are chemicals that evaporate quickly and change form into a vapor very rapidly. Nail polish made up of the chemical acetone is an example of something that volatilizes; once it is poured out, it dries very quickly. Of these volatile chemicals, 81% of them have major effects on human health, such as damage to the brain and nervous systems, because they can be inhaled, ingested, or absorbed through the skin very easily. This is why volatile compounds are of such a great concern (Garrison et al. 2011, 676). There are three groups of volatile compounds used in fracking that have adverse effects on human health—ozone, hydrogen sulfide, and BTEX compounds.

Ozone “naturally exists at high altitudes above the earth’s surface and acts as a barrier against solar radiation and intensified surface heating” (Garrison et al., 2011, 676). Ozone can also develop at low altitudes when hydrocarbons, which are compounds made up of carbons and hydrogens like benzene, are combusted during the drilling and the production of oil and gas (Garrison et al., 2011). This is when ozone hinders carbon dioxide and oxygen exchange as ozone molecules accumulate in lungs and directly affect human health. This “can lead to early aging of the lungs and result in symptoms such as asthma, respiratory inflammation, emphysema, and other pulmonary disorders” (Garrison et al. 2011, 676). In the Dallas-Fort Worth area in Texas, where drilling sites are present, there was an elevated level of recorded carcinogenic

hydrocarbons (Garrison et al., 2011, 676). Ozone would be considered an air contaminant (Shelley, 2011).

Hydrogen sulfide is a compound that “is released through the venting and flaring of natural gas throughout the extraction and refining processes” (Garrison et al., 2011, 676). Venting is a “process of directly releasing gas into the atmosphere and is primarily done for safety precautions” (Garrison et al., 2011, 676). This process occurs throughout many stages. It is more hazardous to human health than flaring of natural gas because gas is combusted, which then reduces air pollution. Since both of these processes occur frequently during fracking, hydrogen sulfide was detected in the air as well. Hydrogen sulfide is not only very toxic, but also causes a rotten egg smell (Shelley, 2011). Some indications that individuals are exposed to hydrogen sulfide for a short term are: “nausea, headache, shortness of breath, sleep disturbance, throat and eye irritation” (Garrison et al., 2011, 676). Symptoms for long-term exposure include “paralysis of the olfactory nerves, respiratory, inflammation, chronic bronchitis, and chronic tearing of the eyes” (Garrison et al., 2011, 676)

BTEX stands for benzene, toluene, ethylbenzene, and xylene. All four of these compounds are carcinogenic hydrocarbons. These highly volatile compounds are found in high concentrations at natural gas sites (Garrison et al., 2011, 677). Some sources of these compounds are from stationary and truck diesel engines, flaring, venting, and dehydration of natural gas (Shelley, 2011). They are known to be easily absorbed in the brain, bone marrow, and overall body fat. BTEX compounds have been linked to many serious health effects in humans, such as leukemia, kidney failure, negative effects on the cardiovascular systems, damage to the liver, and genetic changes (Shelley, 2011).

These three groups are the main chemicals that cause the most abundant health effects. There are different exposure pathways that humans come in contact with these chemicals.

Exposure Pathways

Humans are primarily exposed to chemicals that are used during fracking through drinking contaminated underground water and breathing in polluted air. Both of these measures are uncontrollable for citizens who live near fracking sites. Water and air pollution caused by fracking “can cause direct physiological harm including damage to the eyes, skin, sensory organs, respiratory tract, gastrointestinal track, and nervous system” (Garrison et al., 2011, p. 679).

Another pathway in which humans come into contact with fracking chemicals is through agriculture. Pennsylvania’s Department of Environmental Protection did a case study in Shippen Township, Pa., in 2010, to analyze the disposal of wastewater from drill sites. This study found that there was a leak from a “double lined” wastewater pit that caused the surrounding vegetation to die off. This leak also contaminated the surrounding farm ponds and springs that livestock drink from (Garrison et al., 2011, p. 679). The pond also had unusually high levels of strontium present. Strontium is a radioactive element that is a byproduct of oil and gas operations (Garrison et al., 2011). This leak leads to concerns that livestock and vegetation can be affected by similar situations and these can affect certain communities’ livelihood.

Cattle and vegetation in areas near fracking sites may be entering the consumer market as contaminated products without customers’ knowledge (Garrison et al., 2011). Leaking pits with wastewater and sludge are contaminating areas with fracking fluids, radioactive material, heavy metals, volatile compounds, acrylic polymers, and other extremely hazardous substances (Witter

et al., 2008). Soils are then taking up all these chemicals, which then contaminate the consumer crops. Crops also undergo stunted growth because of the increased release of methane and other volatile compounds into the air caused by the flaring at fracking sites (Garrison et al. 2011). These crops can also be used as feed for the livestock. There is maybe a link between cattle reproduction and gas extraction procedures. A study found that “an increased risk of stillbirths linked to exposure to flaring sour gas (gas with high levels of hydrogen sulfide)” (Garrison et al. 2011, p. 679). Not only does this affect agricultural and human health, but it is also affecting farmers financially.

Another way in which individuals experience health problems from fracking is through stress. Fracking causes great stress to a community. An area in which extraction of natural gas or any other natural resource occurs, experiences a “boom-bust” cycle (Brasier et al., 2011). This is when there is a sudden growth and decline in a community. The decline occurs once the resources are used up and individuals do not receive any more advantages being present in that area. Bradford County, Pa., is where fracking occurs and is experiencing the boom part of cycle. This area has experienced a sudden increase in the population because of the increase in fracking activity. There is an influx of workers and other individuals who are coming into this area as the fracking and economy activities grow (Brasier et al., 2011). This area experiences community stresses, which in turn, affects the individuals in the area.

It has been known that stress can cause mental illnesses. A clinical psychologist in Hawley, Pa., Kathryn Vennie, stated that she has seen patients “who are seeking support because of the disruption to their environment” (Brasch, 2012). Fracking can cause anxiety to individuals, which Venniestates, “can produce mental and physical problems.” Other psychological health problems may occur in communities that experience inadequacies from population booms. There

tends to be an “increased prevalence of ‘divorce, suicide, and alcoholism [are common] in impacted communities’” (Garrison et al., 2011, p. 679). During the boom part of the cycle, a community most likely experiences a “degraded quality of life” (Garrison et al., 2011, p. 679). A lot of hostility is present in the community because of the stresses fracking may impose on the individuals.

Health Problems

There is no definite list of health problems that are directly caused by fracking, but there are individuals who have reported health changes and claim it is from fracking pollutants. Those living closer to fracking sites have reported higher rates of symptoms and health changes (Gas Patch Roulette, 2012). Doctors and toxicologists have stated that individuals who live near fracking sites often exaggerate their health changes and these beliefs are usually short lived (Lustgarten&Kusnetz). Below are some examples of individuals who have claimed their illnesses are from being exposed to fracking pollutants.

Mary McConnell is from Bedford County, Pa., and lives near the Columbia Gas Storage Field. She breathes in air that she claims has pollutants in it. She has headaches, difficulty breathing, sore muscles, and some other health issues. She had blood drawn, and there were levels of methane detected. She currently wears a gas mask around her house to avoid impairing her health even further (Zook, 2010).

Susan Wallace Babbs is from Parachute, Co., and lives near gas wells. She breathes in chemicals such as benzene, a carcinogen, tetrachloroethene, a dry-cleaning solvent (NY Dept. of Health, 2003), and 1,4-dichlorobenzene, used to fumigate moths (EPA, 2007). She claims she

was vomiting, had diarrhea, lesions, body pain, and an elevated heart rate. Her neighbors also had similar symptoms (Lustgarten&Kusnetz).

The Strudley family is from Garfield County, Co. They live near an Antero Resources gas well. They experience two exposure pathways, which are breathing in air and drinking underground water. Some symptoms they experience are rashes, nosebleeds, and sudden blackouts (Colson).

The Parr family live in Wise County, Texas, near 21 gas wells. They say they are exposed to flaring contaminants through air pollution. Lisa Parr's symptoms are rashes, breathing difficulties, nausea, headaches, loss of balance, and other neurological problems. Her husband Bob's symptoms are nosebleeds, balance, and other neurological problems. Their daughter Emma's symptoms are asthma, rashes, and nausea. Lisa stated that she compared her medical bills with a log of spills, releases, and air testing from gas wells. She claims that her medical incidences correspond with these environmental events (Parr, 2010).

It is important to remember that these examples may be skewed because these individuals live near fracking sites and are most likely against it. A physician may not have diagnosed these cases and stated that fracking was the cause. But it is good to be informed by these examples and have an idea of what fracking may cause.

The Endocrine Disruption Exchange (TEDX) created a summary statement of the potential health effects of chemicals used during fracking. They discovered that 47% of the products used during fracking contains endocrine disruptors (TEDX, 2). These "are chemicals that interfere with the endocrine system, including development and reproduction" (TEDX, 2). The endocrine system is essential for the body to function. It is a system of glands and hormones

that regulate “body growth, response to stress, sexual development and behavior, production and use of insulin, rate of metabolism, intelligence and behavior, and the ability to reproduce” (TEDX, 4). They discovered that crystalline silica, methanol, and isopropanol are the top most used chemicals in fracking. The chemicals cause 7, 11, and 10 health effects, respectively (TEDX, 6).

Just like any type of extraction of natural resources, a community undergoes a boom and bust cycle, which is a rapid growth and decline (Braiser et al. 2012, 34). Having this present in an area affects individuals differently. Resident’s attitudes span four stages if they live near a fracking site. The first stage is when these individuals are enthusiastic about the idea. The residents are excited and have positive expectations for the project. The second stage is when they undergo uncertainty of about fracking. The residents are not sure what the long-term effects are, what the health effect may be. The third stage these individuals undergo is panic. The residents realize that there are some unexpected outcomes that affect their daily lives. The fourth stage is adaptation. Once all the natural resources are extracted, the permanent residences need to learn how to adjust to the drastic changes. These stages do not just apply to a community where fracking occurs, they apply applies to any type of extraction of a natural resource. (Braiser et al. 2012, 34)

Since these four stages generally occur within a community, there are many social impacts that are created. Hostility develops among residents throughout this cycle and causes many stresses (Braiser et al 2012, 47). There is a lack of housing created in a community because of the great influx people coming in because of the fracking. This then causes an increase in traffic congestion and traffic violation (Briaser et al. 2012, 47). There are cultural differences that arise between the permanent residents and the new comers. The newcomers don’t have an

attachment and care to a town like the permanent residents do. A division between the “haves” and “have-nots” develop. The “haves” would be the fracking companies and individuals who are benefitting from the fracking activity. The “have-nots” would be the individuals who have been exposed to water or air contamination and have developed health problems. In impacted communities there tends to be an increased rate of divorce, suicide, and alcoholism (Braisier et al. 2012, 49). All these various stresses cause different types of mental and physical problems toward individuals. This is why it is important to note how communities can be negatively impacted.

Case Study Analysis: Garfield County, Colorado

In Garfield County, Co., there are 4,521, oil and gas, active wells (Witter et al., 2008). The Colorado Oil and Gas Conservation Commission (COGCC) reported that there were 1,549 spills in this area between a four-year period, January 2003-March 2008. Twenty percent of these spills involved water contamination. Salts, hydrocarbons, radioactive material, metals, drilling fluids, and sludge were detected in the drinking water (Witter et al. 2008, 4). Having this contamination can lead to a health threat to individuals who live in this area and drink these waters.

A study in 2006 conducted by the Garfield County Board of County Commissioners tested the water sources that individuals use in the area. This included testing domestic wells, water wells, irrigation wells, monitoring wells, air sparging wells, springs, seeps, ponds, and rivers. They found that “out of 184 locations, 135 locations had detectable levels of methane” (Witter et al. 2008, 21). BTEX chemicals were detected at high levels in the areas that were tested that had the highest measurement of methane. This study concluded that areas that had

both BTEX chemicals and methane were contaminated by gas development activities (Witter et al. 2008, 21).

The Colorado Department of Public Health and Environment (CDPHE) tested the air quality at certain sites in Garfield County during the time period of 2005-2007 to see if increasing gas drilling activity affected the air quality in the area. Of these sites, 86% had hazardous benzene levels. The following chemicals were also detected at levels that could produce carcinogenic or non-carcinogenic health effects: methylene chloride, tetrachloroethene, trichloroethene, 1,4-dichlorobenzene, m,p-xylenes, and 2-hexanone. Toluene and acetone were also detected but not at levels of concerns (Witter et al. 2008, 18). The table below explains these chemicals and these possible cancer classifications.

Table 1. The toxicity values of chemicals of potential concern. These chemicals were the most frequently detected in the air. (U.S. Dept of Health and Human Services. 45)

Compound	Cancer		Noncancer	
	Health Cancer blood factor (mg/kg/day)	Cancer classification	Chronic RfC (µg/m ³)	Target organ (Critical effect)
Acetaldehyde	0.0377 I	Probable human carcinogen (B2) Nasal and laryngeal tumors in animals	9.0 I	Respiratory (Degeneration of olfactory epithelium)
Acetone	NC	NC	30000 II A	Neurological (Delayed visual reaction, general weakness, headache)
1,3-Butadiene	0.1 I	Known human carcinogen (A) Lymphomatous cancer and leukemia in humans	2.0 I	Reproductive (Ovarian atrophy)
Benzene	0.027 I	Known human carcinogen (A) Leukemia in humans	10.0 A	Immunological (Decreased lymphocyte count)
Crabonaldehyde	1.9 ^{II} H	Possible human carcinogen (C) Hepatic neoplastic nodules and hepatocellular carcinoma in animals (oral study)	NA	NA
Ethylbenzene	0.00875 C	Probable human carcinogen (B2) Ratid tumors in animals (oral study)	1000.0 I	Developmental (PK mortality)
Formaldehyde	0.0433 I	Probable human carcinogen (B1) Nasopharyngeal and lung cancer in humans (limited) and nasal cancer in animals	9.9 A	Respiratory (Histopathological changes in nasal tissue in humans)
Toluene	NC		6000.0 I	Neurological and respiratory (Neurological effects, other effects: degeneration of nasal epithelium)
1,2,4- Trimethylbenzene	NC		7.0 I	Neurologic, Respiratory, Immunologic (Weight, hemoglobin, drunkenness, anemia, altered blood clotting, chronic asthma (in animals))
1,3,5- Trimethylbenzene	NC		9.0 I	Neurologic, Respiratory, Immunologic (Weight, headaches, drunkenness, anemia, altered blood clotting, chronic asthma (in animals))

Notes: Sources of toxicity values: A= AT2DR - Minimal Risk Level (MRL); C= Cal EPA; I= EPA; least I- EPA IRIS
^{II} Based on 100 mg/kg/day body weight of EPA's oral cancer slope factor
 NC = Non-Carcinogen; N/A= Not Available

CDPHE and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) concluded that benzene only posed an intermediate health risk because of many uncertainties. There was no way of knowing if the results are truly representative of the exposure because samples were only taken for 24 hours, so there was no way of knowing if the chemicals were at the minimum or maximum exposure peaks (Witter et al. 2008, 18).

Exposure of children is of particular concern because these children are going through developmental stages and may be exposed to harmful chemicals through air pollution and water contamination. A study conducted by the Saccomano Institute in Grand Junction, Co. stated that children in Garfield County had an increase asthma rate (Witter et al. 2008, 26). A survey conducted on children who lived within 1500 feet of fracking facilities in Pennsylvania found 19 health symptoms that were unusual to be present at a young age (Gas patch roulette, 3). A Texas hospital located near drilling sites, “reported that asthma rates currently are three times higher than the state average.” This meant that a quarter of young children in the area of six counties had asthma (Matthews, 2012). Although neither the survey nor the hospital report is in Garfield County, it is still significant to acknowledge that fracking sites may have some effects on children.

Work Site Employee Health Concerns

Another group of individuals whose health is of concern are the workers on these fracking sites. They are the ones who are in direct contact with all the fracking fluids and are putting themselves at the highest risks of being present during an accident. Workers are also exposed to dust that contain high levels of respirable crystalline silica during the fracking process (US Dept. of Labor, 1). Crystalline silica is a common mineral in the earth’s crust. It is a major component of sand, clay and stone materials, which is used in concrete, brick, and

glass (U.S. Dept. of Labor, 1). Respirable crystalline silica is a type of crystalline silica that is approximately 10 micrometers in diameter. This is small enough to get caught in workers' lungs and affect the gas-exchange process. It is important to determine worker exposure levels for the proper control measures to be implemented to protect workers' health.

Currently, the half-face respirators that workers use are not a good enough prevention mechanism. These respirators do not protect for silica levels over 10 times the exposure limit that workers have been exposed to, according to the National Institute for Occupational Safety and Health study. Breathing in silica causes silicosis (US Dept. of Labor, 3). This is a type of lung disease, where silica particles are trapped in lung tissues. Some symptoms of silicosis are inflammation, scarring, and reduction of the lungs' ability to take in oxygen (US Dept. of Labor, 3).

There are many other hazards that workers face by working on these fracking sites. They are at risk of being struck by moving equipment, caught in between two moving parts of a machine, also known as pinch points (US Dept. of Labor, 6). Workers are at risk of falling from great heights. They also may be struck by high-pressure lines or get caught in an unexpected release of pressure. Fires or explosions from flowback fluids may occur because flammable materials, such as methane, are present. Workers are not exposed to great lighting and may work in confined spaces without taking the required precautions (US Dept. of Labor, 6). All these possible risks may contribute to serious injury and in some cases death.

The mortality rate in a region and the event of fracking is a relationship to analyze to determine if there is a correlation. While the mortality rates in Garfield County generally

decreased from 2000 to 2005, it drastically increased in 2003. In 2003 fracking activity in this area expanded (Witter et al., 2008, 24).

Conclusion

Garfield County, Colorado, is a good resource to use when analyzing the possible health effects that may arise because of fracking. There still has been no accurate, direct data that prove that fracking causes certain health effects. From this analysis, the trends of the possible health effects are noticeable. The fracking fluids used concerns the public because of the potential hazards they cause. It is important for individuals to take precautionary steps and encourage fracking companies to do so also. More research and stricter regulation are needed. There are many possible ways in which fracking can affect human health that are still not known or obvious to the public.

Stakeholder Interview

Dr. Jill Kriesky was the Senior Project Coordinator at The University of Pittsburgh School of Public Health. She earned a Ph.D. from the University of New Hampshire in economics, an M.S. in economics from the University of Wisconsin-Madison, and a B.A. in economics and political science from Grinnell College. She has been interested in Marcellus Shale issues since 2009.

Q: Because there is so much uncertainty of the health effects from fracking, what do you think that the public and government agencies should be doing in order to protect people's health?

A: At the federal and state government level it would be important to institute the research that would give some definitive answers on what is going on with health impacts. In Pennsylvania,

when the legislature was debating the legislation that regulates Marcellus Shale drilling, the suggestion was made to institute a health registry, which is a way to track what people's health conditions are. This would allow people who do research to follow up, but this did not pass. Nothing has been done on it in state legislature.

I think what they really should be doing is to do a good epidemiology study, a good baseline study, more tracking health of people over time. This study would also need to track exposure to water and air. That is the level of study that needs to be done in order to get agreement among the industry, public, community. Government wouldn't conduct it, but they would fund this type of research.

There are people who live in these communities where drilling is going on having health problems that didn't occur before drilling. They are convinced that it is from drilling. Right now, there needs to be efforts to stop the exposure to the sources you think the contamination is coming from. Local health departments should be providing information for individuals who think that the air will get you sick and water will get you sick. The Southwest Environmental Project is the only organization currently doing this. They provide on line simple recommendations to limit exposures. For example, if you think there are problems with flow back ponds that sometimes overflow and if you think that there is contamination in soil, don't wear shoes in the house.

Q: What are some precautions that the fracking companies should be doing in order to prevent a public scare?

A: I think there are things that are helpful. They are required by law to post the chemicals they are using in the fracking process, unless they are tradeseecrets. This is proprietary

proprietary information to keep whatever competitive advantage they have over their competitors. But often other companies can figure out what they are doing. Secrecy over proprietary chemicals should not be allowed. Such secrecy can cause unnecessary concern to the public. Companies are required to test well water in a certain radius from where they are drilling, and now a few companies are going even further. The other thing is to talk to the community in advance in what they will be doing. The changes in the community are disruptive. They should tell how many truck trips there will be and that there will be a lot of noise pollution and traffic. Being more upfront about what is going to happen in the town and what will happen in the backyard if they are drilling there.

Q: *How have past fracking sites dealt with this concern about health with the public?*

A: There are several high-profile cases in which the companies denied that they were impacting residents' health. But there was some serious contamination and people were getting sick. The homeowners end up in court saying that the fracking companies are destroying their water or air quality. Companies have settled and sometimes bought the property from the people with the complaints. We don't know much about this because the companies have people sign non-disclosure agreements so they cannot discuss proof of harm or the terms of the settlement.

I think a regulatory process needs to be in place and enforced to assure that the process is done safely. Are some companies going to make a greater effort to be sure what they are doing is safe? Well they don't want bad publicity. But this varies a lot depending on the companies. To protect all residents near fracking sites, government enforcement of reasonable regulations is key.

Q: *What do you think are the most concerning health problems that occur from fracking?*

A: No one has really done a complete study. There have been impacts on water and I think those should cause a lot of concern. There has been information how fracking chemicals have gotten into well water. We don't know how much of that water people have drunk, showered in, wash and cooked food in the water.

There is at least one study out now showing that chemicals in the air within a half-mile within a drilling site contained dangerous chemicals, capable of causing cancer in large enough doses. We don't really know how much exposure they really get in these locations. So in the short run, we should be sure that the amount of exposure is limited. There must also be studies to determine the doses to which residents are exposed to nearby fracking over time.

Another big concern in communities where this occurs is a lot of social change like truck traffic, influx in workers, changes in housing market. There are big social impacts and we know that there are social determinants of health that impact quality of life issues for people who don't live directly near a drilling site. They may still feel stress of disagreement among people which in turn can impact health

Q: *Do you know of many hospitalizations have occurred because of fracking?*

A: Difficult problem. There are the community people who are impacted, workers we know nothing about. Anecdotally I have heard of people who work in the emergency room seeing people who have accidents and falls at the drilling pad sites. They sometimes pay with cash which makes it more difficult to research the types of conditions treated. If it is a serious accident, they want to be treated quickly and sometimes they go home. No way to track this. One study that was done by OSHA on silica 2012 because they use sand in the fracking process. The workers on the site are breathing in silica sand and this can be extremely hazardous to health.

They did this study at 11 sites across the country and found incredible amount of sand inhaled.

Q: Any other remarks you might have concerning human health effects from fracking that would be most useful for students at Lehigh University.

A: Lehigh is not in an area where there is fracking nearby. Really what you are most likely to see is related to truck traffic and influx of workers in the area. People who live very close to a fracking sites need to be aware of water, air, and soil pathways. Also what are the social impacts in the broader communities may experience this when the industry comes to the area?

Profiles of Key Individuals and Groups

1. The Environmental Protection Agency is a governmental agency that plays an important role in the possible health effects that fracking causes. They are the ones who monitor the environmental impacts that fracking sites may cause. They test if there is soil, water, and air contamination. These are the various pathways in which individuals are exposed to fracking chemicals. They are currently about to start a nationwide project about the potential drinking water impacts from fracking. At this website (<http://www2.epa.gov/hydraulicfracturing>), you will find a phone number to call if there are emergency events, spills, or releases.
2. The PA Department of Environmental Protection protects PA's environment and safety of its citizens. They work with various organizations that prevent pollution and protect natural resources. The website below is where individuals can report a complaint pertaining to fracking in the Southwest Region of PA.

[http://www.portal.state.pa.us/portal/server.pt/community/southwest_regional_off
ice/13775/environmental_complaints/617091](http://www.portal.state.pa.us/portal/server.pt/community/southwest_regional_office/13775/environmental_complaints/617091))

3. The Pennsylvania Department of Health is another governmental agency that plays an important role with this topic. Since Lehigh University is in Pennsylvania, this would be the specific state health agency to go to for information about the possible health effects from fracking. They work closely within communities to promote optimal health of citizens of the Pennsylvania.
4. The Southwest Pennsylvania Environmental Health Project is a nonprofit environmental health organization. Their main mission is to assist Washington County residents who believe their health has been impacted from natural gas drilling. They have a nurse practitioner who is available for individuals who have a health concern and think it is from fracking. This office provides a lot of information about the possible pathways individuals may be affected from fracking chemicals. (<http://www.environmentalhealthproject.org>)
5. The Endocrine Disruption Exchange, TEDX, is a non-profit organization that is devoted to providing scientific evidence of the possible health and environmental impacts that are caused from endocrine disruptors. One area that they focus are chemicals used in fracking. Many of the drilling chemicals contain endocrine disruptors. They are conducting research in Colorado and have been a big part of conducting the Garfield County case studies.
(<http://www.endocrinedisruption.com/home.php>)

Web Resources for Additional Information

1. <http://insideclimatenews.org/news/20120321/endocrine-disrupting-chemicals-fracking-natural-gas-low-dose-environmental-health>

This article demonstrates how individuals may have a small exposure to drilling chemicals, which can lead to serious health effects. Chemicals that are endocrine disruptors are explained here.

2. <http://www.youtube.com/watch?v=HqMHesiRVa8>

Dr. Jill Kriesky speaks at the University of Pittsburgh Public Forum about Public Health Impacts from fracking the Marcellus Shale. The University of Pittsburgh is a big player in conducting studies that analyze the potential health impacts.

3. http://www.huffingtonpost.com/2012/05/20/geisinger-health-systems-fracking_n_1531563.html

This article discusses Giesinger Health Systems and its findings on the potential health effects from fracking. Here you will find a video that interviews Professor Tony Ingraffea from Cornell University. He explains the fracking process and why individuals should be concerned about their health.

4. http://energy.wilkes.edu/PDFFiles/Issues/Env10_Potential%20Health%20Effects%20of%20Marcellus%20Shale%20Activities.pdf

Dr. Bernard D. Goldstein is the Interim Director for the Center for Healthy Environments and Communities at the University of Pittsburgh. Here is a slide show of the potential health effects that Marcellus Shale may have. There is information about the effects on a community.

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