Health concerns in Communities exposed to natural gas from Fracked shale,

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Environmental Health Project

Discussion outline

- **Fracking ancient shale beds releases raw natural gas and other chemicals into neighborhoods**
- **Over 1.2 million people are living within 1/2 mile of a shale gas extraction, processing or transporting pipeline in Pennsylvania.**
- **The Environmental Health Project has been examining persons with health concerns.**
- **This discussion will focus on**
  - **the health effects observed in communities,**
  - **the chemicals involved and**
  - **the pathways of exposure**
- **Personal actions available to protect residents who are exposed will be included.**

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Symptoms Reported to EHP Nurse Practitioner

N=113	Individuals reporting	Percentage of total cases
Respiratory	60	53%
Dermatologic	55	49%
Eye	44	39%
Nose & throat	68	60%
Gastro-Intestinal	56	50%
Cardiac	33	29%
Neurological	65	58%
Psychiatric	64	57%
Endocrine	21	19%
Ear/hearing	19	17%

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Health issues

Category	Researcher/author
Gastrointestinal *	Earthworks (2012) Bamberger & Oswald (2012) Ferrar et al. (2013)
High Blood pressure	Subra (2010)
Muscle/joint pain	Earthworks (2012) Subra (2010) Subra (2009)
Neurological *	SWPA (on-going) Bamberger & Oswald (2012) Subra (2010) Subra (2009)
Respiratory *	SWPA (on-going) Earthworks (2012) Bamberger & Oswald (2012) Subra (2009)

Category	Researcher/author
Behavioral/mood/stress *	SWPA (on-going) Earthworks (2012) Ferrar et al. (2013) Subra (2009) Perry (2013) Resick (2013)
Birth Outcomes	Hill (2012) McKenzie (2014)
Cancer risk	McKenzie (2012)
Dermal *	SWPA (on-going) Earthworks (2012) Subra (2009)
Ear, nose, mouth, throat *	Earthworks (2012) Subra (2010) Subra (2009)
Eye *	SWPA (on-going) Earthworks (2012) Bamberger & Oswald (2012) Subra (2010) Subra (2009)

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UNGD Acute Symptom Inventory
(113 patients who met screening criteria)*

RESPIRATORY SYMPTOMS	**cough, shortness of breath, wheezing**
DERMATOLOGICAL SYMPTOMS	**rash, itching, burning**
EYE SYMPTOMS	**itching and burning, blurred vision, dry eye, pain**
NOSE AND THROAT SYMPTOMS	**sore throat, sinus pain, nose bleed**
GASTRO-INTESTINAL SYMPTOMS	**nausea, abdominal pain, diarrhea**
CONSTITUTIONAL SYMPTOMS	**fatigue, weakness, weight change, drowsiness**

*** Screening criteria: Complete intake process, plausible exposure, temporal relationship between exposure and symptom, absence of another likely cause of sympt*om***

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UNGD Acute Symptom Inventory, cont. (113 patients who met screening criteria)*

CARDIAC SYMPTOMS	**heart rate, chest pain**
NEUROLOGICAL SYMPTOMS	**headache, difficulty concentrating, dizziness, numbness/ tingling, word recall trouble**
PSYCHIATRIC SYMPTOMS	**difficulty sleeping, moody/ irritable, anxiety, panic attacks**
ENDOCRINE SYMPTOMS	**hair loss, thinning hair**
EARS/HEARING	**tinnitus, hearing loss**

*** Screening criteria: Complete intake process, plausible exposure, temporal relationship between exposure and symptom, absence of another likely cause of symptom**

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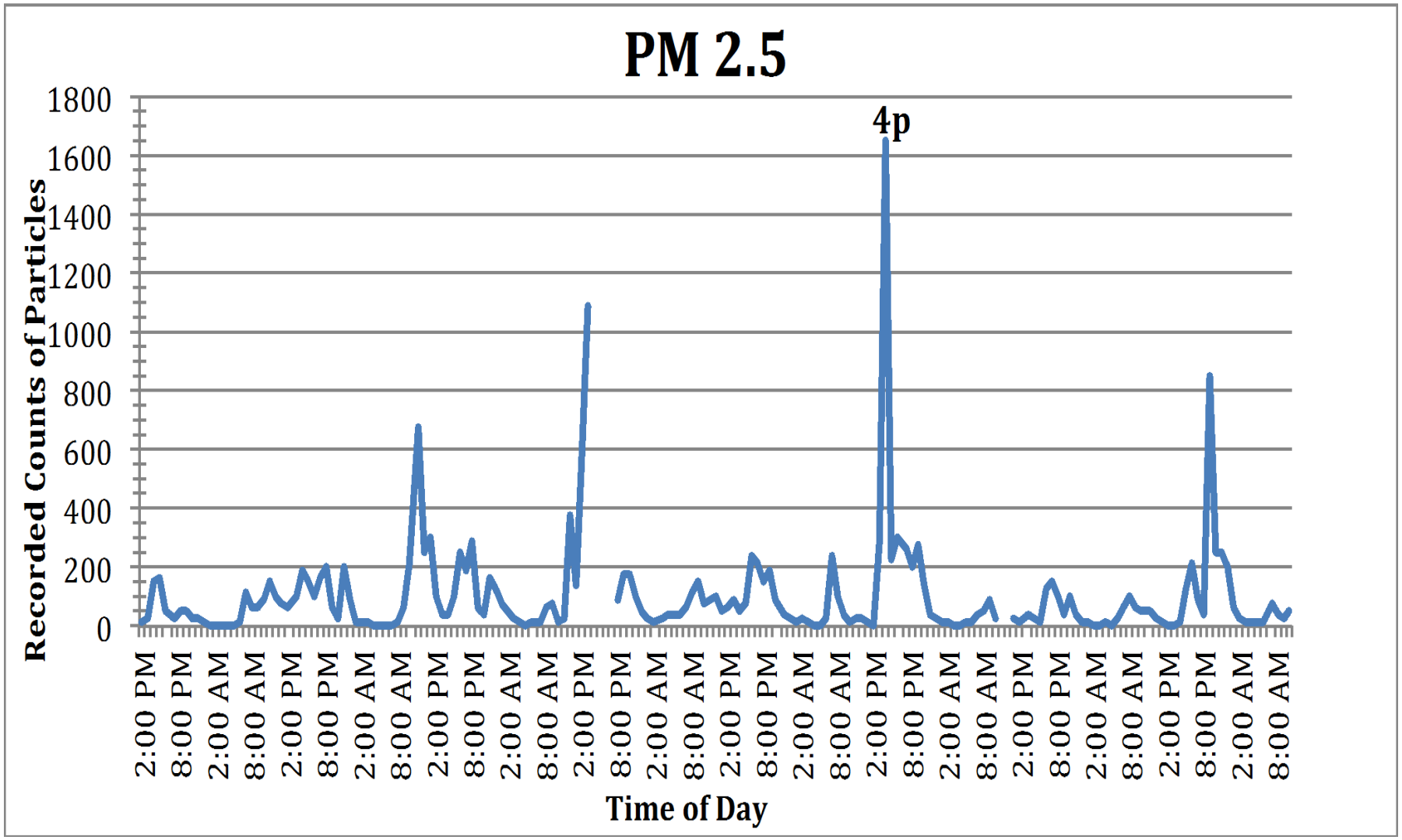
12 Emissions of concern for immediate toxic responses

1. **Barium, Arsenic**
2. **Fluoride salts***
3. **VOCs ***
4. **PAHS**
5. **BTX***
6. **Methylene chloride, (halogenated alkanes)***
7. **Acetaldehyde/Formaldehyde**
8. **Fine particulate matter***
9. **Carbon monoxide**
10. **Glycols***
11. **Silica dust***
12. **Radium and radioactive decay products***
13. **Nitrogen oxides**
14. **Hydrogen sulfide**

Chemicals and Pathways of Exposure

- **Chemicals come from both Fracking fluids and the actual shale deposits.**
- **Exposure pathways are:**
  - **Air emissions from flaring, fugitive emissions and blow downs.**
  - **Water emissions are from waste ponds, disposal, spills and long term storage.**
  - **Soil and food exposures from fallout and other undetermined factors.**

A one-week sample of Dylos results for a house monitored in March 2013



Summary of peak PM2.5 count values for each house, given in number of hours, % total hours, times of day, and maximum peak value.

(Median 50 Cts/0.01ft3)

6 hour average: night, morning, afternoon, evening

House	Number of hours with peaks	% of total hours with peaks	Times of day of peaks*	Maximum Peak Value
1	12	8.5	N	2711
2	11	5	M, N	756
3	3	2.5	M	171
4	1	0.5	N	201
5	8	2.5	A, E	556
6	11	7.7	A, E, N	576
7	31	8.7	M, A, E	1654
8	29	15	M, A, E	991
9	9	12.6	M, E, N	1057
10	23	32	M, A, E, N	844
11	7	16	M, E	3846
12	2	1.4	E	203
13	3	4.3	M	164
14	57	34.3	M, A, E, N	1761

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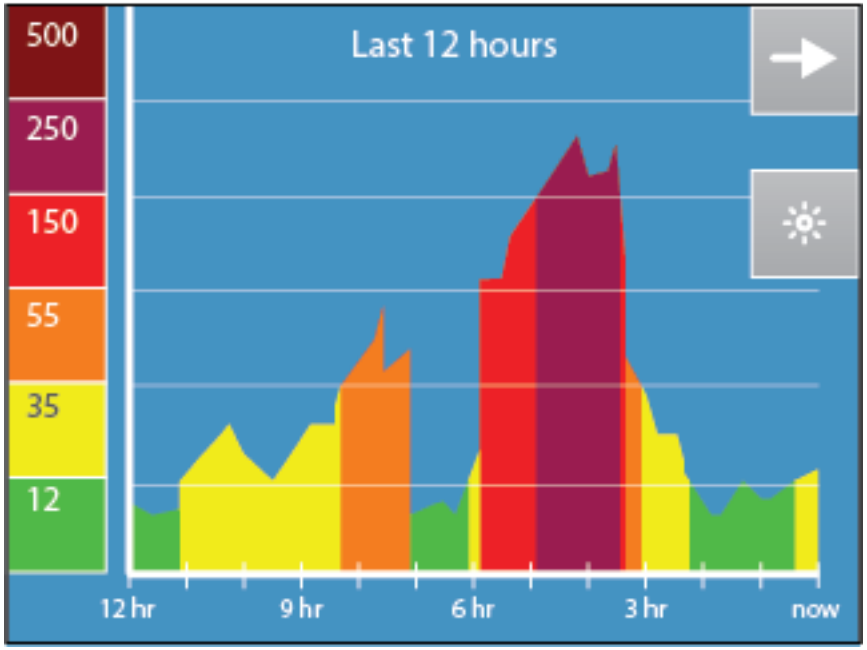
Review of reported symptoms

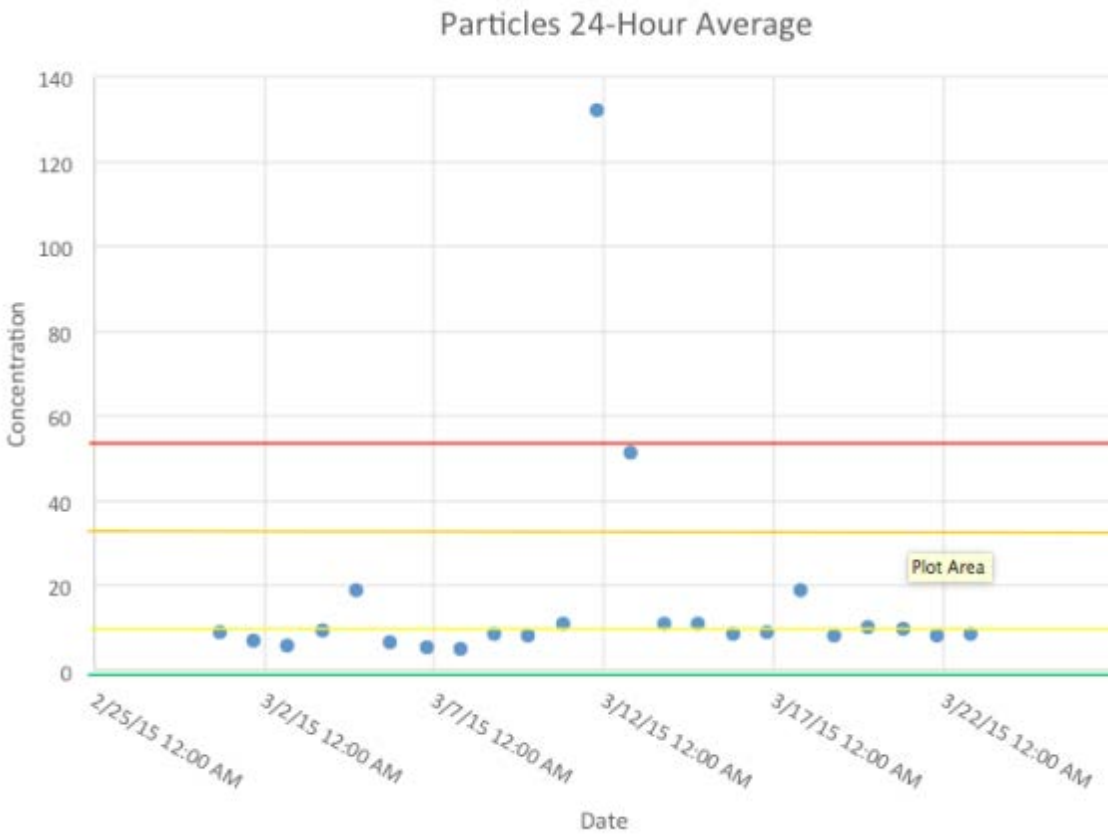
- Symptoms might be persistent, transient, or intermittent. These variations in symptom presentation are consistent with the changing and episodic nature of exposures.



Speck PM 2.5 Air Monitor Screenshot

How Health Protective are Current Air Quality Standards?

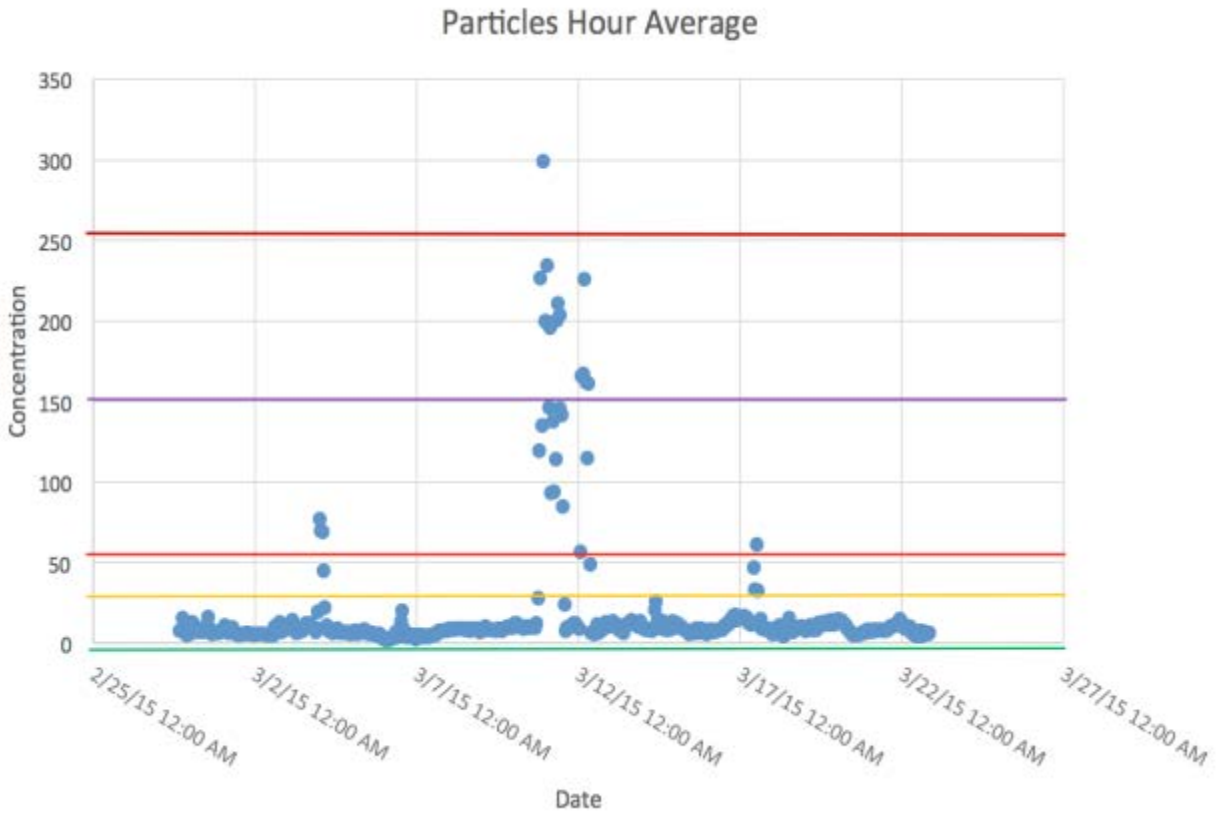
- **The Environmental Protection Agency (EPA) has National Air Quality Standards for six principal pollutants, known as 'criteria pollutants', which include Particulate Matter ($PM_{2.5}$).**
- **Currently, health standards only exist for 24-hour and yearly time averages.**
- **As of 2012, the $PM_{2.5}$ 24-hour standard has been changed to 35ug/m^3 (orange line).**



Two spikes above the health standard

Air Quality Standards, Continued

- **When EHP analyzes $PM_{2.5}$ data, we look at what we consider to be a 'health protective' level.**
- **EHP recommends that a 1-hour average is a more accurate health standard, rather than the EPA's 24-hour standard.**

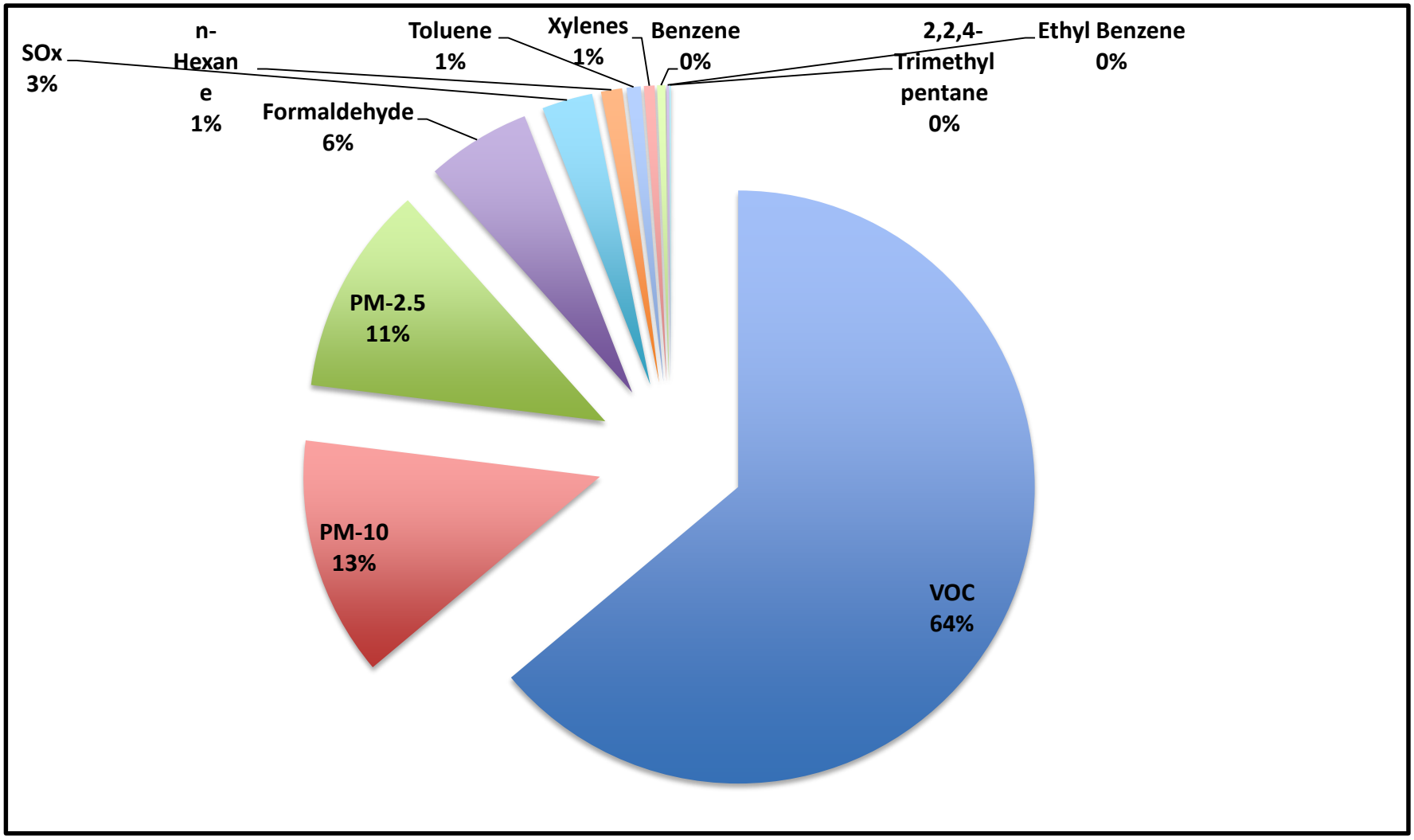


Six noticeable spikes above the EPA approved health standard of 35ug/m^3 as well as 2 spikes considered hazardous.

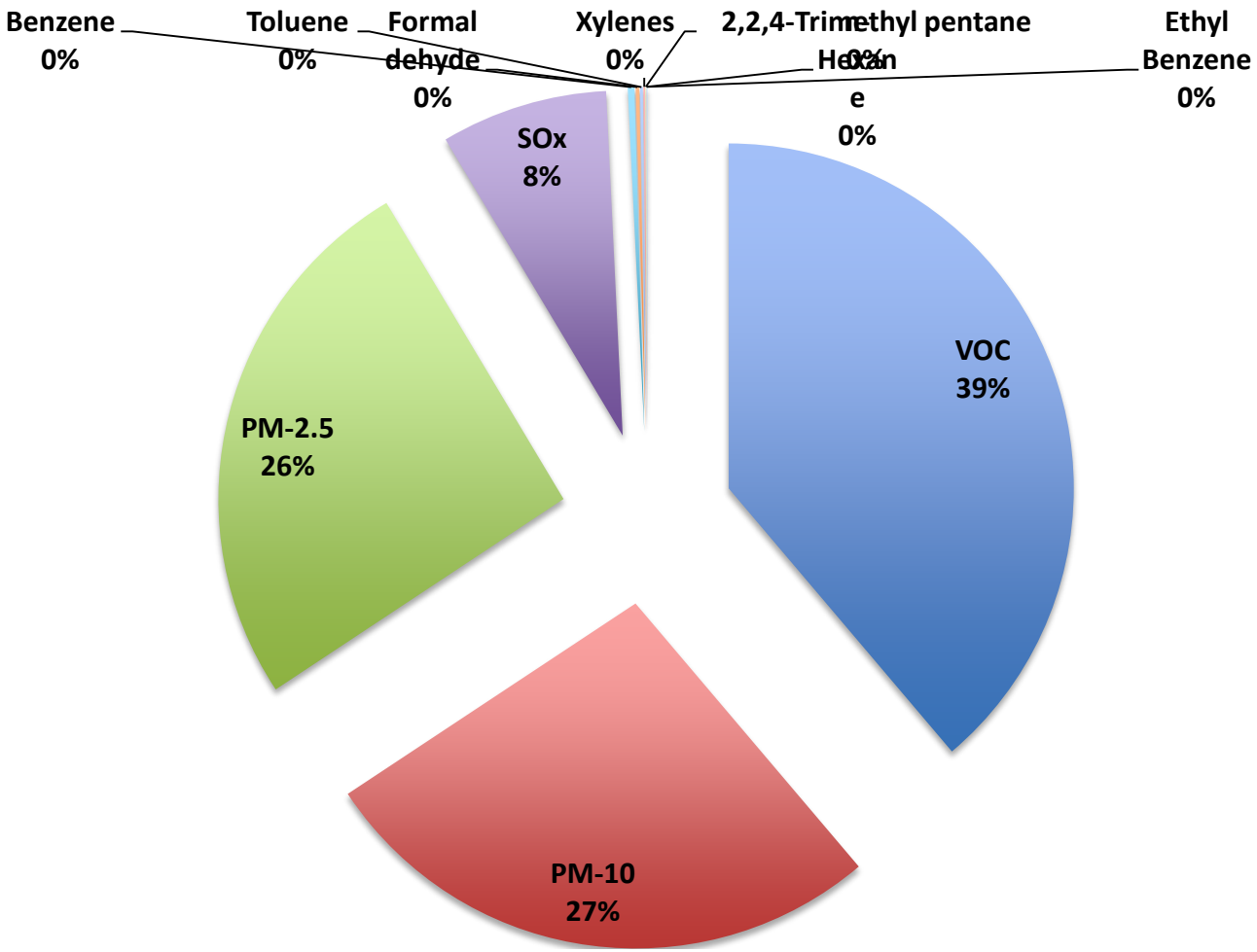
$PM_{2.5}$ in Emissions from UOGD

- EHP measures $PM_{2.5}$ as an indicator of emissions.
- The following slides will show emissions, both Particulate Matter (PM) and Volatile Organic Compounds (VOCs), ***reported by industry to DEP in terms of tons/year.***
- The actual weight of each emission pollutant is not given as we are looking at the proportion of overall emissions. The chemicals are reported in percentages.
- Carbon Monoxide and Nitrogen Oxides are the most commonly-found emissions (responsible for 80% or more of emissions) and are therefore removed from charts.

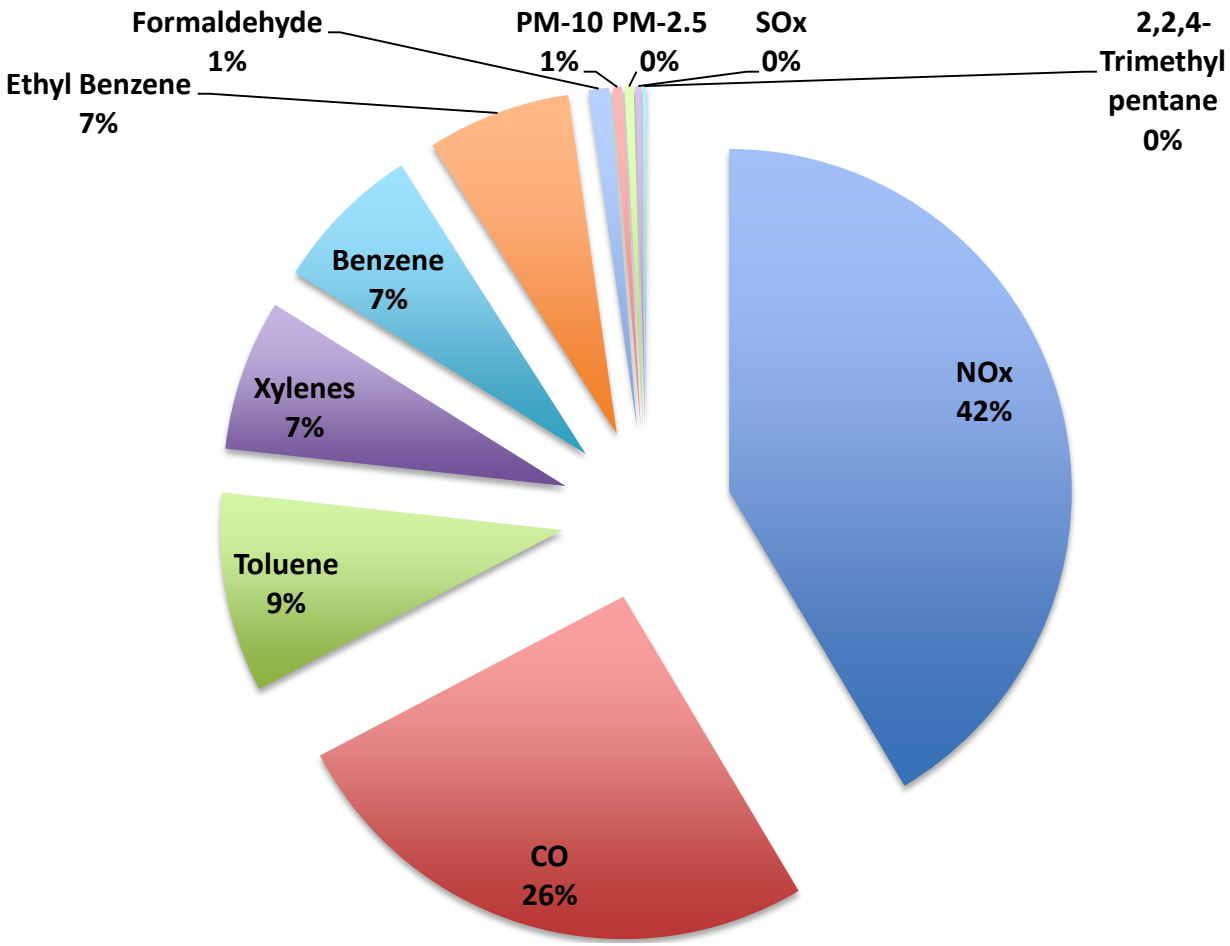
DEP Summary of the Inventory Data Reported Emissions



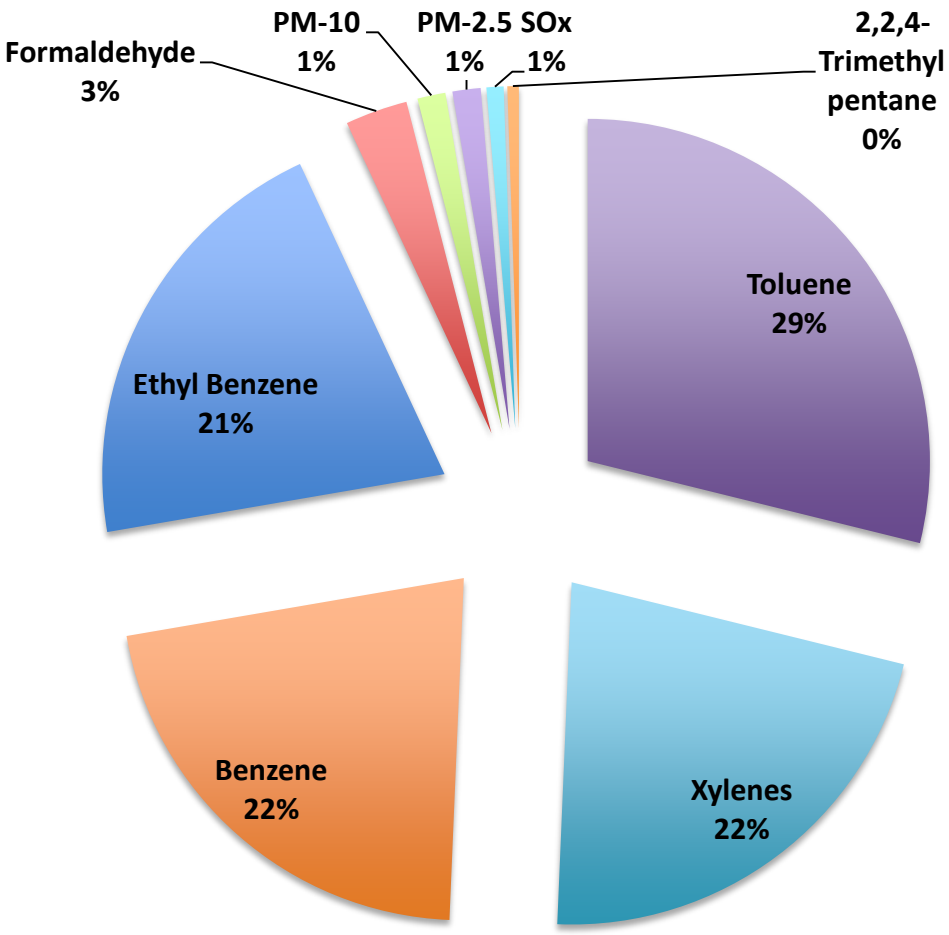
DEP Reported Drill Rig Emissions



DEP Well Completion Emissions



DEP Compressor Blowdowns



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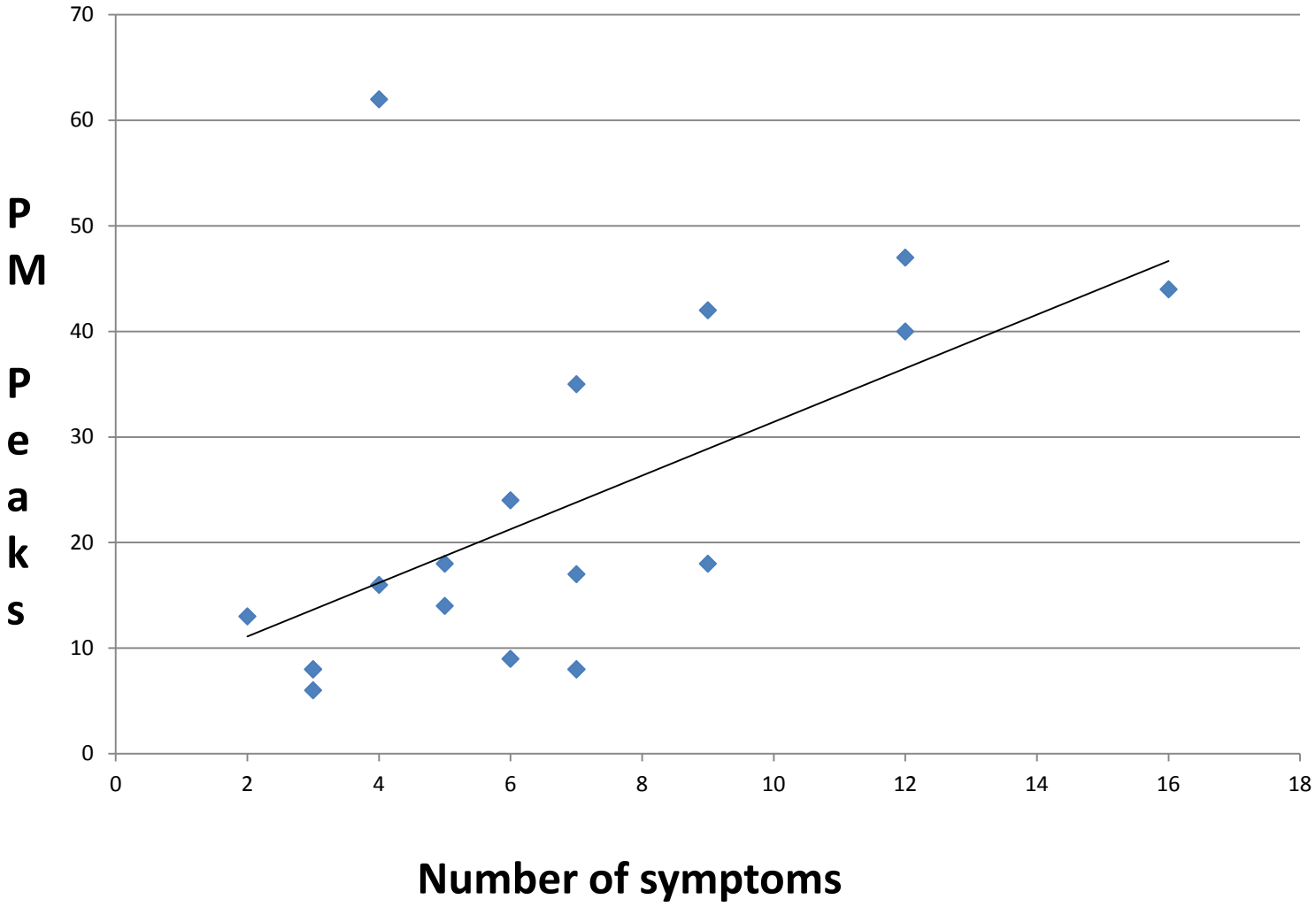
Number of PM 2.5 Peaks and Symptom Type

	Eye, Ear, Nose, Throat					Respiratory		Neurological					Stress		GI		Cardiological	
Number of Peaks	Eye Irritation	Tinnitis	Dry-Mouth	Nose bleed	Throat irritation	Cough	SOB Wheezing	Head ache	Concentration	Memory loss	Dizziness	Tingliness Numbness	Anxiety/stress	Sleep Issues	Abdominal Pain	Nausea	Dyspnea /Dizziness	Palpitations
62						X	X	X					x					
47	X				X	X	X	X		X	X	X			X	X	X	X
44	X	X	X	X	X	X	X	X			X	X	x	x	X	X	X	
42	X	X			X	X		X			X	X				X		
40	X				X	X	X	X		X	X	X			X	X	X	X
35	X			X			X		X	X			x	x				
24	X					X	X					X	x	x				
18	X	X			X				X			X						
18	X	X			X	X		X			X	X				X		
17					X	X	X		X	X			x		X			
16						X	X	X					x					
14		X						X				X	x	x				
13													x	x				
9	X					X	X					X	x	x				
8	X			X			X		X	X			x	x				
8					X	X	X		X	X			x		X			
8	X												x	x				
8					X								x	x				
6					X								x	x				

PM 2.5 Peaks vs Number of symptoms



At the cellular level, responses to inhalation of a toxin are determined by

- The intensity of the exposure
- The frequency of the exposure
- The duration of the exposure
- Interaction of components of the toxic mixture

Health findings and air monitoring reports are in conflict

Health Findings

- **Reports of acute onset sequale in humans :**
  - **respiratory,**
  - **neurologic,**
  - **dermal,**
  - **vascular bleeding,**
  - **abdominal pain,**
  - **nausea, and vomiting**

Monitoring Reports

- **Assurances from air monitoring data that untoward exposures are not occurring.**
  - **Burnet Shale Texas (Bunch et al- 2013)**
  - **Marcellus Shale Ambient Air sampling (Pennsylvania DEP 2010)**
  - **City of Fort Worth gas Air Quality Study (ERG 2011)**

Human exposure timeline with UNGD activities and human health risk

(0 is none and 10 is certain)

Site activities	Diesel fumes	Frac fluids	Drilling fluids	Produced water	Biocides	Gas volatiles	Radio activity	Human exposures: outdoors	indoors	Food	water
Pad preparation	7	0	0	0	0	3	0				
Vertical drilling	7	0	8	0	4	4	7	Yes	yes	No	Yes
Frac drilling	10	10	8	0	4	3	8	Yes	yes	No	Yes
Frac process	10	10	0	0	7	4	0	Yes	yes	No	Yes
Well Finishing	5	8	7	10	7	10	9	Yes	yes	yes	Yes
Flaring	3	8	7	10	7	10	9	Yes	yes	yes	Yes
Frac ponds	3	7	7	10	10	10	10	Yes	yes	no	Yes
Gas processing											
(dehydrators)	3	2	0	6	4	9	7	yes	yes	no	no
(condensers)	0	2	0	0	4	9	7	Yes	yes	no	no
Compressor stations	10	0	0	0	0	9	8	yes	yes	Yes	no
Pipe line venting	0	0	0	0	0	9	8	yes	yes	yes	yes
Pipe line failures	0	0	0	0	0	9	9	yes	yes	yes	yes
Service traffic	8	0	0	8	0	3	0	yes	yes	no	no
Spills	5	4	4	8	6	6	9	yes	yes	yes	yes
Disposal sites	5	0	3	10	10	10	10	yes	yes		
Metering stations	2	0	0	0	0	9	8	yes	yes	no	no

What needs to be looked at next?

1. **Start with Steinzor, Subra and Sumi (2013) "New Solutions"**
   a. **Look at pattern of health effects**
   b. **Look at the exposure findings**
   c. **Compare to other studies and reports**

2. **The impact of the Non Disclosure Agreements**
3. **The capacity of the county Health Districts to respond to personal outbreak reports**
4. **Proximity to schools, hospitals etc.**
5. **Housing options for the poor.**
6. **Training of medical providers**

1. **Can there be disclosure when there are multiple sub contractors?**
2. **Air emissions. Illustrates the scope the limitations**
3. **Drinking water threat cannot be addressed using present methodology.**
4. **Social disruption goes beyond the traffic impacts and set back distances**

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Our mission is to respond to individuals' and communities' need for access to accurate, timely and trusted public health information and health services associated with natural gas extraction.

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The Southwest Pennsylvania Environmental Health Project

Health Evaluations and Support

- Nurse Practitioner
- Health exams
- Consultations
- Referrals for health services
- Health Provider education
- Clinical toxicity profiles

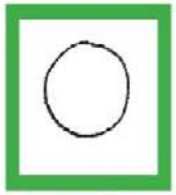
Accurate, Trusted and Timely Public Health Information

- Identification of exposure pathways
- Measurement tools
- Consultation of water reports
- Assessment of air exposures
- Evaluation of health risks
- Information assessment

Help individuals at risk

- **Real time air and water monitors.**
- **Devices to remove particulate and gases from home air.**
- **Provide an air model to determine periods of high risk.**
- **Management guidance for cleaning homes.**
- **Warning signs of health effects.**
- **Worry and anxiety support systems.**
- **Access to immediate safe locations.**
- **Need to know conditions the make them susceptible to injury.**
- **Clear understanding of the limitations of government to assist them.**

Guide to Air Quality Near Shale Gas Sites



Sunny Day
any wind or no wind

Cloudy Day
no wind or light wind

Cloudy Day
windy

Calm Night
scattered to no clouds

Night
scattered to no clouds, windy

Cloudy Night
no wind

Cloudy Night
light wind to windy

Healthy:	Moderate to Healthy:	Unhealthy:	Very Unhealthy:
No associated health risks/concerns.	Unusually sensitive people, older adults and children should avoid exertion and outdoor work.	Avoid extended or heavy exertion, close windows, go somewhere else, turn on air filter.	Avoid extended or heavy exertion, close windows, go somewhere else, turn on air filter.

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FOR DETAILED INFORMATION, CONTACT 724-260-5504

How to protect against health impacts from unconventional natural gas development (UNGD)

Cut off contamination from air

Clean your house often, especially areas where your children play. Use a vacuum that can fit a HEPA filter. Don't sweep with a broom.

Vent the air in places where you use water. Open windows or run an exhaust fan in the bathroom, kitchen and laundry room. If you have a stove fan, always use it while cooking.

Let fresh air in your home when it is breezy outside, usually in the middle of the day. Unhealthy air can collect closer to ground level when the air is still, usually in the morning and evening.

Take off your shoes and wipe off pets' paws and fur before going inside. This will help to keep contamination from soil out of your home.

Cut off contamination from water

Don't rely on one-time water tests to tell you if your water is safe to drink and use. Accidents and contamination can happen at any time.

Consider using bottle water for drinking, cooking and making drinks like baby formula, coffee, juice.

If you must drink or cook with your tap water, leave it *uncovered* in a pitcher or bottle in the refrigerator overnight before using it.

Stop drinking your water if you or someone in your family has stomach pain or discomfort, confusion, nosebleeds, muscle pains or other unusual symptoms.

If your water burns your skin or causes a rash, take showers and baths somewhere else. Go see your doctor and call our office to see our nurse practitioner.

Monitor changes in your health and environment

Keep a health diary. Write down changes in your health and changes you notice in your water or air. Share this information with your health care provider.

Remember that children, senior citizens or people with chronic health conditions **are more sensitive**. Pay special attention to changes in their health.

Check the conductivity of your water. This can tell you if your water changes and if there may be a problem with your water. EHP offers the CATTFish, to monitor conductivity, to individuals on well or spring water.*

Monitor particulate matter (PM) in the air. EHP offers the Speck air monitor to help individuals identify times when particulate matter concentrations are high within their home, and other times when exposures may not be occurring.*

Find ways to cope with the changes in your environment. EHP offers a free program, *Take Steps to Health*, to help individuals improve their health and manage some of life's stressors.

*The Speck and CATTFish cannot identify specific chemicals in your air or water. They warn you that changes that may warrant extra testing are occurring.

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There is a human health dimension

- It is clear that people who lose of drinking water and are ill are under extreme stress.
- They have sick pets and farm animals.
- They see no serious effort to follow up on their concerns by any local, state or federal agency.
- They are labeled as anti-gas and ignored.
- Their need for safe water becomes a weapon.

The Central Questions

- **What are the health issues associated with UNGD of shale and implications for health care providers?**
- **What is the evidence that would indicate a clinical problem for providers?**
- **What characteristics define the health issues of immediate concern, and what is needed to mitigate the damage?**

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Summary of the Evaluation

- The analysis shows that protocols used for assessing compliance with ambient air standards do not adequately determine

  - the intensity, frequency or durations of the actual human exposures to the mixtures of toxic materials released at UNGD sites.
  - Typically used periodic 24-hour average measures underestimate actual acute exposures by an order of magnitude.
  - NAAQs and other available reference standards for ambient air are set in ‘forms’ that prevent determination of acute health risk.
  - Standards do not consider the most likely synergistic potential of the mixture-combinations of toxic air emissions.
  - Standards needed for acute toxics are not available for most compounds
  - Measures are incomplete (Only 6 of 11 primary chemicals identified by BSSI measured by TCEQ)

- Application of basic, air dispersion modeling shows that local weather conditions and time of release are strong determinates of the timing and intensity of individual exposures.

Conclusions

- **People are exposed to toxics through air, water and soil.**
- **The exposures are periodic and intense for several hours.**
- **Regulatory Air and water screening will not detect the hazard.**

- **Most likely acute physical symptoms “rash”, headache/ fatigue, respiratory, nose bleeds, GI, depression.**
- **Biomonitoring methods need to be developed.**

- **Interventions and support at the patient level help coping.**
- **Individuals must monitor their health and exposure status.**
- **Sense of community trust and social capital is destroyed.**
- **Federal, State and Local public health and environmental agencies are not able to effectively respond. The Public Health Process has become rule bound, restricted to standard environmental tests of air and water and research health protocols.**