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From a Public Health Perspective: Fracking and Other Unconventional Oil and Gas Extraction Techniques in California

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Abstract:

California strives to be a leader in clean energy, yet it is the third largest producer of oil and gas. To tackle the need for a cleaner environment, free of toxic chemicals, the Center for Environmental Health (CEH) established a Healthy Energy Choice campaign. CEH and the Healthy Energy Choice Program collaborate with other organizations and communities to shine light on the public health impacts associated with fracking and other oil and gas extraction methods. The following paper is a summary of a 300- hour field work experience completed at the CEH's Healthy Energy Choice Program specifically with an analyzes of the public health effects associated with fracking and other oil and gas extraction in California. Various core competencies that are part of the University Of San Francisco Master of Public Health program were addressed during the fieldwork project.

Introduction:

California has some of the largest oil and gas reservoirs in the world, making oil and gas production one of the leading industries in the state (CCST Vol 2, 2015). There are 52 giant oil fields in the state, and each has more the 100 million barrels of known recoverable oil (CCS T Vol 2, 2015). New technologies, such as hydraulic fracking, acidization and other unconventional oil and gas methods have allowed the extraction of crude oil and natural gas from low permeability formations that were once to expensive to exploit (Earthworks, n.d). Many politicians and Californians see the economic benefits associated with this boom and fail to evaluate the full multi-step extraction process as well as the impact it has on our climate, water, air and overall public health.

This paper will provide an overview of the public health impacts associated with fracking and other unconventional oil and gas extraction in California and a summary of a fieldwork experience completed in the Healthy Energy Choice Program at the Center for Environmental Health. This fieldwork experience marks the culmination of the University of San Francisco's Masters in Public Health Program.

Background on the Fracking and Unconventional Extraction Process in California

The process of oil and gas extraction in California is mixture of traditional techniques as well as fracking and other wells stimulation techniques that are also referred to an unconventional extraction. Generally, unconventional oil and gas extraction involves the identification of oil or gas deep the shale rock. Once a location has been identified, a well, about 2,000 ft deep, is drilled underneath the earth's surface. The shallow vertical wells are unique to California, and are of great concern because of their proximity to the surface and the high probability of them intersecting and contaminating protected groundwater (CCST Vol 1, 2015). Thousands of gallons of water, sand, and chemicals, are pumped into the well at high pressure, creating fissures that frack the shale rock and allow the release of trapped oil and natural gas (CCST Vol 1, 2015). Buoyancy, then allows the oil and gas to flow back up the well to the surface, where it is processed, refined, and shipped to the market. Throughout the entire process, from the drill, chemical use, extraction, refining and shipping process, there are ample opportunities for water and air contamination as well as other direct and indirect public health impacts. After analyzing the entire oil and gas extraction social justice issues can also be seen as an indirect results related to this industry

Operators have drilled oil from California for decades. About 95% of the hydraulic fractures in the state however take place in the San Joaquin Basin, which is where the majority of the state's oil and gas is produced (CCST Vol 2, 2015). San Joaquin Valley also has some of the state's' highest level of poverty and poor health outcomes. A report

compiled by the San Joaquin Valley Public Health Consortium found despite being the state's richest source of oil and gas sources, it receives less public health funding from state and federal sources compared with counties with similar populations (Capitman, & Bengiamin, n.d). Such evidence highlights the social injustice and disparities in economic, social, and health factors that affect communities living near oil and gas extraction sites.

Hydraulic fracking and other unconventional oil and gas extraction techniques inject chemicals into the ground that contain dozens of chemicals In California, hundreds of chemicals such as strong acids, bases, silica, biocides, and quaternary ammonium, have been voluntarily disclosed by oil and gas operators (CCST Vol 2, 2015). Of the known chemicals being used, many are known carcinogens, endocrine disruptors, neurotoxins, and chemicals known to cause reproductive and neurological harm (CCST Vol 2, 2015). Many of the oil and gas companies claim a number of chemicals to be "trade secrets" and therefore, the exact quantity, toxicity, and bioaccumulation properties of these chemicals remain unknown. The lack of transparency in the data makes it difficult to assess the public health risks posed by a great portion of the stimulation chemicals used. The lack of knowledge and the potential sources for these chemicals to pollute water sources and contaminate the air is of great concern that should be taken seriously.

Dangers of Fracking: Polluted groundwater

Fracking and other unconventional oil and gas extraction can result in the release of contaminants into the environment, including into surface water and groundwater.

The release can occur during chemical transport, storage, mixing, well stimulation, well operation and production, wastewater storage, treatment and disposal (CCST Vol 2, 2015).

Dangers of Fracking: Excess water use

For every barrel of oil produced, up to 10 barrels of produced water is returned to the surface along with oil and gas (CCST Vol 2, 2015). The contaminated produced water and flow back water, contain chemicals additives used in the stimulation process and any compounds that may have formed due to the transformation, degradation, or reaction between the chemical additives. In addition, produced water and flow backwater pulled up from the ground, can also contain heavy metals such as lead and arsenic or radioactive compounds that naturally occur in the soil, and residual oil and gas (CCST Vol 2, 2015).

In California, 60% of produced and flow backwater is disposed of in unlined pits or sumps. Such fluids have the potential to seep into the ground and contaminate surface or groundwater(CCST Vol 2, 2015). Recovered fluid, fluid that is returned to the surface before production even begins, is often mixed with water to dilute its content and stored in tanks prior to its reuse or disposal (CCST Vol 2, 2015). 99% of these fluids are injected into underground Class II disposal wells. Injection wells are classified according to the location and type of fluid injected. According to the US EPA, Class II wells are used to inject brines and other fluids associated with oil and gas production (CCST Vol I, 2015). Numerous disposal wells are located near active faults resulting in great concern for induced seismic activity and the aftermath that can result for it (CCST Vol 2, 2015). California is in a state of drought, therefore water is a scarce and valuable resource that

should be protected and restricted for everyone, including oil and gas companies. Oil companies have been able to market their produced water as a water source for farmers to use in agriculture. Companies have not been required to test this water for anything except total dissolved solids (TDS) and boron (CCST Vol 2, 2015). The used and effects of produce water for agriculture has not been studied. Therefore to a very minimum, the state should establish and enforce regulation that prohibits the use of produced water on crops sold for human and animal consumption until further testing has been done.

Dangers of Fracking: Air Pollution

Fracking and other unconventional oil and gas extraction have the potential to emit greenhouse gases (GHGs), as well as volatile organic compounds (VOCs), nitrous oxides (NOx), toxic air contaminants (TACs) and particulate matter (PM). These contaminate the air, and increase the risks of health impacts associated with poor quality.

Thousands of gallons of water and large quantities of proppants and chemicals are transported via diesel trucks. Diesel trucks along with the machinery used to pump the chemicals and water into the well, are great contributors of NOx and particulate matter 2.5 (PM 2.5). Particulate matter is known to increase the incidence of asthma, cardiovascular disease, chronic obstructive pulmonary disease, and premature death as well as of cancer and infant mortality (CCST Vol 2, 2015). Venting and flaring of waste gas, fugitive emissions from the site results in methane, VOCs and TACs. These are emissions that contribute to poor air quality which results in additional respiratory and health impacts such as reduced

lung function, asthma and emphysema, which affect the most vulnerable ,pregnant women, children, and the elderly(CCST Vol 2, 2015).

Dangers of Fracking: Vulnerable Populations

Literature suggests that the TAC's exposure is risk factors associated with oil and gas development and its public health effects are proportional to its geographic proximity to active oil development (CCST Vol 3, 2015). This is of great concern in California because half a million people, live within one mile of a well that has been fracked or stimulated (CCST Vol 2, 2015) Over 61, 000 children attend school within one mile of a stimulated oil or gas well (Ferrar, 2014). Children attending school at such a close proximity are exposed to high levels of air toxins, including volatile organic compounds (VOC's) such as benzene, toluene, ethylbenzene, and xylenes (BTEX) , all of which may have serious impact on their social, emotional and physical health.

Besides the many health impacts associated with fracking and other oil and gas unconventional techniques, there are multiple social issues associated with the process as well. In California, school districts with greater Hispanics and non –white students are more likely to contain more oil gas drilling and stimulation, highlighting a social environmental justice issue (Ferrar, 2014). Children are the most vulnerable to these impacts due to their small frame. Despite the potential harm, the oil and gas industry does not have any setback rules or regulations that prohibit the industry from extraction near vulnerable populations.

Agency

Potential health impact issues include the need for comprehensive, ongoing health and demographic data collection, risk modeling, and public awareness campaigns. There are national campaigns dedicated to shining light on the environmental, social, and public health impacts associated with fracking and oil and gas extraction, however because fracking and oil extraction is different in California, applying the same mythologies, and conclusions to California may not be accurate. Therefore, campaigns, research, and tools that address the uniqueness of California regarding oil and gas extraction, are needed.

The Center for Environmental Health is a national non-profit organization based in Oakland, California. CEH protects people from the use of toxic chemicals via four lasers focus programs; the Flame Retardant, Litigation, Policy, and Healthy Energy Choice Program.

The toxic Flame Retardant Program is working hard to eliminate the use of cancer causing chemicals found in flame retardants used in furniture and baby products. The Litigation Program invests in products and tests them for harmful chemicals labeled under California's Proposition 65. CEH has exposed chemicals in hundreds of these products and has taken legal action to eliminate health hazard, such as arsenic, lead, cadmium and other chemicals. The Policy Program helps lobby at the state's capitol and D.C , to push for strong bills that protect people from the chemical industry

This fieldwork experience took place within the Healthy Energy Choice Program. CEH's Healthy Energy Choice Campaign, is working on nationwide and state campaigns to bring attention to the health risks associated with hydraulic fracking and other oil and

natural gas extraction techniques. The Healthy Energy Choice team has co-written two peer reviewed studies exposing the air pollution risks from fracking and the threat fracking chemicals pose to women and children. New York cited these two studies when the state decided to ban fracking in December 2014. Most recently, CEH is working with communities in the San Joaquin Valley and Los Angeles region to test for air pollution around oil and gas extraction sites in California. The program is also working with other organizations to engage physicians and health professionals to help educate the public about the health risks from fracking. CEH is actively recruiting and drafting resolutions for healthcare association to adopt and aid in a public stand for healthier energy solutions.

A grand majority of fracking and other oil and gas extraction takes place near communities of color. As a result communities of color suffering from health disparities are affected disproportionately by the consequences resulting from oil and gas extraction. Stakeholders, such as researchers, community leaders and members, policy makers, environmentalist, as well as health professionals are collaborating in various strategies and Community-Based Participatory Research (CBPR), to keep oil and gas in the ground and preserve the environment and health of future generations.

Implementation

The initial intention of the fieldwork experience at CEH was to assist in the engagement of health professionals and physicians as advocates against fracking and unconventional oil and gas extraction, and develop a presentation to educate others on how California is different form other states, in regards to fracking and oil and gas

extraction. The following learning objectives and goals were identified at the onset of the project:

- **Goal One:** Establish a connection and relationship with Healthy Energy Team and CEH Staff.
- **Goal Two**: Increase my knowledge on fracking and other forms of energy extraction.
- **Goal Three:** Help engage and educate health professionals on the health effects of fracking and other unconventional oil and gas extraction techniques.

To support and aid in the implementation of each goal, learning objectives and specific activities were established (See Appendix A).

Attendance of biweekly staff meetings and participation in the CEH's annual fundraiser gala provided an opportunity to learn about the framework and strategies behind a non-profit. Participating in weekly meeting with my mentor and with the California's Health Professional Engagement working group, provided opportunities to work with other nonprofits and strategies on health professional engagement. The meetings also provided a roundtable opportunity to discuss current events involving local, national and international oil and gas extraction.

To fully understand the complexity of the topic and the health, social, and the environmental justice issues involving the oil and gas industry, acquiring knowledge about crude oil and natural gas extraction process was essential (Goal Two). To address Goal Two, a brown bag presentation highlighting the process of oil and gas extraction, the social and health impacts involved as well as CEH's projects, was presented. One of the greatest

issues behind oil and gas extraction, specifically in California, is the lack of epidemiological studies that examine the health effect associated with the industry.

Regulatory exemptions have favored the oil and gas industry without considering the health and environmental impact of California's and future generations. In 2005 Energy Policy Act exempted the natural gas and oil industry from seven major federal laws included the Safe Drinking Water Act and Clean Air Act, designed to protect public health (Kosnik, 2007). In September of 2013, Governor Brown signed Senate Bill 4 (SB4) in an attempt to establish a regulatory program for oil and gas well stimulation treatments (DOGGR, 2015). SB4 required the Division of Oil, Gas and Geothermal Resources (DOGGR) to prepare an Environmental Impact Report and mandated an independent scientific study to be completed. Regulations on hydraulic fracturing and other oil and gas unconventional extraction went into effect in January of 2015, as required by SB4 (DOGGR, 2015). However, it is important to note that regulations were set in place without any of the recommendations stated in the independent study, released July 2015. SB4 attempts to acquire data by requiring the oil and gas companies to apply for permits to conduct fracking, publicly disclose the chemicals used, and monitor groundwater and ordered an independent study (DOGGR, 2015). However the quality of data collected is questionable considering that oil and gas companies are granted trade secretes provision. Because the regulations are fairly new, the data available is also very limited.

As the fieldwork continued, Porter Ranch, a suburb community in Los Angeles, reached out to CEH's Healthy Energy Choice Program. Porter Ranch is located near well site and members seek to document the health outcomes they are experiencing. Having prior

experience conducting research surveys and having recently read and analyzed various health studies related to fracking in other states and regions in California, the learning objectives were modified to include the development and coordination of a community health survey for the community of Porter Ranch. Updated learning objectives are included (See Appendix B).

Considering that the grand proportion of oil and gas extraction takes place in Kern County, a trip to down to the San Joaquin Valley was organized to provide insight into the region. My mentor, as well as two nurses, one physician, and a staff person from the Alliance of Nurses for Healthy Environment (ANHE), came along. The trip was guided by local community members active in anti-fracking movements to provide us with their local knowledge of the area. Having nurses and a physician join served as an engagement opportunity as well as a pilot tour for future public health professional who are engaged in the cause. With a digital camera, pictures were taken that documented oil wells feet away from schools, crops, and recreational area were documented. Percolation pits and flares caused by the burning of excess gas were also captured and included in a collage (See Appendix C). The trip provided a first hand opportunity to speak with local community members and leaders about the public health effects of fracking and other unconventional oil and gas extraction happening near them. Experiencing the odors and seeing the mile long backdrop of oil wells rigs near schools, and agriculture was motivational.

Findings/ Results

Achieving goals one, two, and three, proved to be an effective use of resources, research, and outreach to health professionals and community members. Goal four which involves survey design and implementation was partially completed. The development of a survey was successfully completed. Due to the limited amount of time, and conflict in schedules, the survey implementation, analysis and evaluation were postponed for late 2015. The administration of Porter Ranch's community health survey is expected to start in late October 2015, after the completion of this fieldwork project.

As for the community health research survey design, pilot testing the survey in the coming months, will make sure that everyone in the sample will understand the questions and understand them in the same way. Since community members initiated the request and are actively campaigning against fracking in the community, it is likely for the survey administration will happen. Constant communication and collaborative work in the meantime, will support the sustainability of this project.

Review of published health studies and discussions with scientists, physicians, nurses, community members as well as leaders in environmental studies provided a wealth of knowledge and input regarding successful community and public health leadership engagement and surveying methodology. The knowledge and input was incorporated into the design of Porter Ranch's community health survey and should be used by CEH' s Healthy Energy Choice team on their ongoing work to and mission to keep oil and gas in the ground.

A review of previous resolutions adopted by national organizations and analysis of CEH's overall mission, resulted in draft resolution that aligns with CEH's Healthy Energy Program's overall mission. The draft resolution is a working document that aims to create resolutions for various public health organizations (See Appendix D). The draft resolution was designed to serve as a bank of "whereas" that provides supporting information to references and a spectrum of "resolved" statements that act as specific action items. Various "whereas" and "resolved" statements will be pulled and modified from the resolution draft to compile resolutions specific to respective public health organization. Future interns or CEH members will be able to use the draft resolution as a resource to which they can add and modify "whereas", "resolved" and supporting information as new data and studies are published.

In a near future, the resolutions will be presented to the respective organization with the hopes of having them take a public position on the issues. It will also help engage individual members from the various public health organizations to become public champions against the health effects of fracking and unconventional oil and gas extraction.

With the creation of a draft resolution bank, the next step was to create and prioritize the list of health professional schools and association. The creation of this dataset involved s online searches. Finding the proper contact and establishing a connection with leaders of these schools and associations proved to be a challenge. Since a great proportion of the fieldwork was expected to occur over June through August, vacations often interrupted communication threads. As a result, establishing a trustful connection with

health associations was difficult. Conversations between health professional associations continue and will continue past the fieldwork project.

Compiling data and evidence to create a California specific presentation and factsheet draft was successful. The presentation was presented during CEH's brown bag presentation series and was recorded to serves as a learning tool for future inters and staff. A challenge to the California specific factsheet was finding the proper language and format to address physicians and health professionals. The factsheet is a working document that once completed and approved by CEH's staff, will serve as a tool for future health professional engagement and education (See Appendix E).

Public Health Significance

The public health significance addresses the following issues in addition to Community Based Participatory Research:

- **Data to inform stakeholders.** The limited data available raises serious questions and concerns about the chemicals and quantity of chemicals Californians are being exposed to. Current regulations fail to incorporate recommendations called by the mandated independent study. Insufficient, trustful data makes it difficult for stakeholders and policymakers to assess the scope and magnitude of exposure, and related morbidity or mortality among affected populations.
- **Interventions to alleviate inequitable inequalities.** Bioethicists and public health professionals have wrestled with theories of justice as relates to inequalities within the context of medical care and public health generally. Here, the

disproportionate impact of unregulated activities affecting those with the highest level of poverty and the poorest health outcomes does not require a high threshold to warrant intervention.

- **Stakeholder engagement to conduct CBPR and address unmet needs.**

Researchers and scientific experts are partnering with local community members that provide them with valuable inside (street) knowledge and who are living and experiencing the effects of oil and gas extraction. The various strategies behind the fieldwork demonstrate key facets in the use of CBPR. The strategies behind engaging phycisicans and public health professionals provides an outlet for credible sources of information to advocate for better enforced regulations for the oil and gas industry to abide by. Engaging and incorporating community members in the research process during the community health survey will allow them to combine their knowledge and take action for a cleaner and safer environment. By joining forces and working towards a common goal, communities and health professionals can shine light on the health effects and social justice issues involving oil and gas extraction and disseminates the information gathered for others to learn.

Competencies Addressed

The achievement of the learning objectives via the 300 hour fieldwork experience, demonstrated the achievement of the University of San Francisco's Masters of Public

Health competencies. The fieldwork project provided an opportunity focus greatly in the following core knowledge areas:

- **Environment Health.** Documenting the health outcomes of Porter Ranch residents living near oil and gas wells via a community health survey, may provide data to identify potential public health problems caused by environmental contamination.
- **Public health services administration and leadership.** Questioning the current regulations governing the oil and gas industry highlights a broken system that disproportionately affects the delivery and quality of care of individuals negatively impacted by the industry.

The following Interdisciplinary and cross cutting values were addressed:

- **Cross cutting values of communication and informatics.** The attendance of meeting, as well as presenting verbal and written information to CEH's staff, health professional, and community members. Fluency in Spanish facilitated the interaction and accurate documentation of communication between a diverse group of people and cultures, specifically with community members of Kern County.
- **Public health biology.** The analysis of the chemicals use during the oil and gas extraction process requires the use of public health biology to be able to contextualize the physiological process and health effects associated with these chemicals.

- **System thinking.** To think critically about the dynamic social, economical and health interactions involved during the entire process of oil and gas extraction.

The core knowledge areas and cross cutting values provide a framework to address the following MPH competencies during the fieldwork project:

- **(#1) Assessing, monitor, and review the health status of populations and their related determinants of health and illness.** Environmental and health data is available via governmental websites such as the California Department of Public Health and DOGGR. Information available on these sites and web can help review the health status and determinants of health of those living near oil and gas wells. Once completed, the Porter Ranch community health survey will aim to provide data that will help inform, monitor and asses the health status of the community.
- **(#6) Articulate the relationship between health care delivery and financing, public health systems, and public policy.** Legislative and regulatory mechanisms in place fail to incorporate the public health effects that result form the oil and gas extraction process.
- **(#7) Apply evidence-based principles to the process of program planning, development, budgeting, management, and evaluation in public health organizations and initiatives.** Applying evidence-based principles to the process of program planning allowed for the creation of culturally appropriate survey for the Porter Ranch community.

- **(#9) Identify and apply ethical, moral, and legal principles in all aspects of public health practice.** Seeking information to properly evaluate the oil and gas industry in California reveals a discrepancy in ethical, moral and legal practices that need to be address in order to protect the health and quality of life of future generations.

Personal Reflection

The fieldwork experience at the Center for Environmental Health allowed me to step outside my comfort zone. During the beginning of my fieldwork project, having the opportunity to attend a strategic meeting in which various environmental health groups participated in, allowed me to get gain the basic knowledge needed to understand the field and scope of the public health issues surrounding oil and gas extraction. Getting organizations to collaborate on a common issue was a challenge I did not foresee. To overcome this challenge, framing the issues and strategies to align with the vision and mission of specific organization was essential.

The fieldwork experience was a collaborative process in which my mentor, Sue Chiang introduced me to knowledgeable people in the field. Seeing the data they are able to produces and how the data collected is being used to influence politics that ensure the safety and well being of the public, was also very encouraging. Pursuing a PhD in Environmental Science was something I had not considered before, however having the opportunity to discuss with leading scientists and PhD students in the field of environmental science has sparked my interest in the field. Realizing the data gap, lack of transparency and quality in the available information provides an opportunity to conduct

research and learn more of the process and effects of unconventional oil and gas extraction techniques

Developing the survey, fact sheet, presentation, and draft resolution has contributed to my professional and personal growth. Once completed, the survey administration, and analysis that occurs post this fieldwork project will also be a milestone in my career as a public health professional. Without the expertise, patience, and support of my mentor and Healthy Energy Choice Program team, the experience, and of knowledge acquired would not have been the same. Being able to communicate with my preceptor to address my concerns, projects, and availability was invaluable and detrimental for the completion of my fieldwork experience. It has taught me to look at the entire process of things in order to probably assess their impact on communities and individuals.

Conclusion

The successful completion of the fieldwork project marks the end of the University of San Francisco's Masters in Public Health program. The experience of working with CEH's Healthy Energy Choice program allowed for networking and amplified my knowledge on the public health effects resulting from unconventional oil and gas extraction in California. The deliverables accomplished during the fieldwork project will hopefully aid fellow interns at CEH and contribute to the Healthy Energy Choice campaign to spread awareness on fracking and other unconventional oil and gas extractions. This rewarding experience has given me confidence and motivation to seek additional challenges and opportunities to learn more about the impacts toxins and chemicals have on public health. Overall, this

fieldwork experience as well as the MPH coursework provided knowledge and experience vital to my preparation as a public health professional.

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University of San Francisco: Fieldwork Goals and Objectives
Student: Hilda Cerros
Preceptor: Sue Chiang
Site: Center for Environmental Health (CEH)

Goal 1: Establish a connection and relationship with Healthy Energy Team and CEH Staff			
Objective: Establish weekly communication with preceptor			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Meet in person with preceptor weekly	April 27, 2015- August 14, 2015	Hilda Cerros	Notes and action steps from meetings
Communicate with preceptor via email or phone regarding immediate issues	April 27, 2015- August 14, 2015	Hilda Cerros and Sue Chiang	Notes from email or phone communication
Participate and present in CEH's Brown Bag Lunch series	April 27, 2015- August 14, 2015	Hilda Cerros	Fracking presentation and notes from other presenters
Objective: Establish communication with Healthy Energy Team			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Attend CA Engaging Health Professions meeting	April 27, 2015- August 14, 2015	Hilda Cerros	Notes and action steps from meetings
Attend biweekly staff meeting	April 27, 2015- August 14, 2015	Hilda Cerros	Notes and action steps from meetings

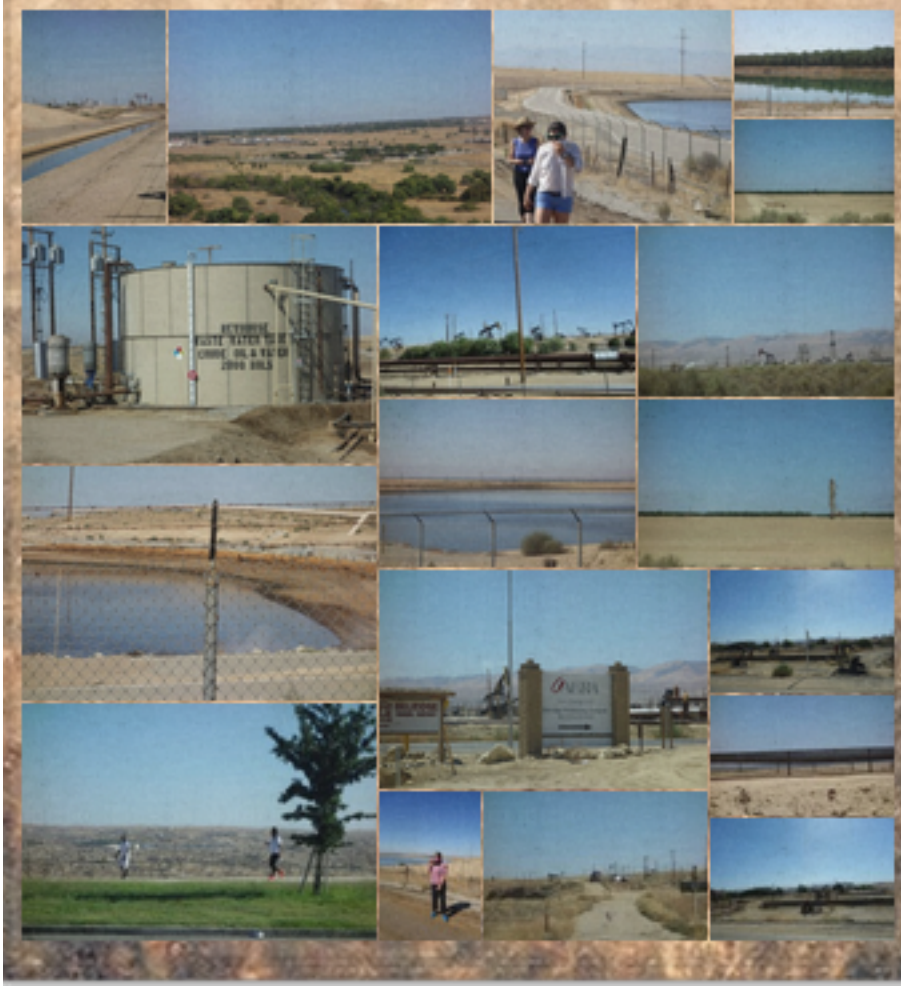
Goal 2: Increase my knowledge on fracking and other forms of energy extraction			
Objective: Demonstrate an understanding of the health and environmental impacts of fracking			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Read relevant literature and reports on fracking and other well stimulation methods	April 27, 2015- August 14, 2015	Hilda Cerros	List of literature read
Highlight major points from Advance Well Stimulation Technologies in CA report released August 2014 i	June 1, 2015- July 1, 2015	Hilda Cerros	Notes
Watch/ participate in webinars series on energy extraction including how resource extraction and energy development may contribute to adverse reproductive health and developmental effects in humans	May 4, 2015- May 11, 2015	Hilda Cerros	List of webinar series watched
Objective: Conduct a literature review including relevant literature and research studies on the health impacts of fracking			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Complete a literature review of existing studies, review articles on the effects of facking	June 22, 2015-August 3, 2015	Hilda Cerros	Literature review results

Goal 3: Help engage and educate health professionals on the health effects of fracking			
Objective: Identify health professionals to target and engage			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Research and continue list of organizations who have taken a stance and have adopted a position on fracking at a national or local level	April 27, 2015- August 14, 2015	Hilda Cerros	List of organizations, associations, or groups
Compile a list of nurses, medical, and public health associations and schools in CA to target	April 27, 2015- August 1, 2015	Hilda Cerros	List of schools and association
Objective: Help educate health professions regarding the health effects of fracking			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Create a CA specific fact sheet for health professional on fracking health effects	June 22- August 14, 2015	Hilda Cerros	Fact Sheet development
Help draft and send position statements to target nurses, medical and public health associations in CA	April 27, 2015- August 14, 2015	Hilda Cerros	Number of positions statements/letters

Goal 4: Coordinate a community health survey for Porter Ranch, California			
Objective: Develop, implement and analyze a survey to document health outcomes in Porter Ranch, California			
Activities	**Start/End Date**	**Who is Responsible**	**Tracking Measures**
Develop a health survey	July 6- August 14, 2015	Hilda Cerros	Survey deliverable
Create survey protocol manual	July 6, 2015- August 1, 2015	Hilda Cerros	Survey manual
Train volunteer surveyors	October 25, 2015	Hilda Cerros	Attendance list
Survey administration, collection and analysis of data	November 2015- January 2016	Hilda Cerros, Save Porter Ranch volunteers	Data collected
Survey evaluation	Febuary 2016	Hilda Cerros, Save Porter Ranch volunteers	Comments and evaluation

Please see following page for Appendix C.

Kern County



Resolution:

Subject: The Center for Environmental Health recommends action to address the environmental and health impacts of fracking and other unconventional oil and gas extraction techniques in California

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WHEREAS, fracking and other unconventional oil and gas extraction involves drilling thousands of feet below the earth's surface and pumping millions of gallons of water at high pressure (1); and

Chemical disclosure

Whereas, hundreds of chemicals, including strong acids, bases, silica, biocides, benzene, formaldehyde and many more which are undisclosed as "trade secretes" are used to maximize the extraction of underground oil and gas create the potential for introduction of hazardous materials into the environment (1,2); and

WHEREAS, the toxicity and biodegradability of more than half the chemicals used in hydraulic fracturing remains uninvestigated, unmeasured, and unknown (3); and

Chemicals/Health Impacts

WHEREAS, the handling of high concentrations chemicals in hydraulic fracturing and acid stimulation, present potential exposure to humans, particularly during handling and of are particular concern to workers and nearby residents (3, 30, 31); and

WHEREAS, studies of health effects of fracking demonstrate that more that 75% of the toxic chemicals known to be used during both fracturing and drilling phases of oil and gas operations are known to negatively impact sensory organs, such as the eyes and skin as well as the gastrointestinal system and liver. Over half the chemicals show effects in the brain and nervous system while 37 % of the chemicals are known endocrine disruptors and 25% are linked to cancer and mutations (4); and

Water

WHEREAS, oil and gas industry dispose of waste water in underground Class II injection well, re-inject the water for enhanced recovery, irrigation, or dispose of it in unlined percolation pits. Each of these water disposals methods pose challenges and threats to water quality, health, and the environment (3, 21, 26); and

WHEREAS, waste water from fracking adds harmful salts, metals, and radioactive to the toxic mix which cannot be handled by traditional water treatment (19, 20); and

WHEREAS, as the state drought continues, Californian farmers are irrigating crops with recycled water from oil companies (22); and

WHEREAS, Fracking in California is done at shallow depth, increasing water-pollution risk (2, 34)

WHEREAS, there is evidence that fracking has polluted groundwater and surface water in various states including Colorado, Pennsylvania, New Mexico (16); and

WHEREAS, Fracking has the potential to impose short-term and long-term impacts on underground and surface drinking water resources and local air quality (3); and

Air Pollution

WHEREAS, air pollution and numerous toxic air contaminants (TACs) from unconventional oil and gas development can be classified into emissions during preproduction, production, transmission and storage, use, and after well abandonment. Emissions including, methane, benzene, ethylbenzene, and xylene (BTEX), 34 volatile organic compounds (VOCs), nitrogen oxides (NOx), fine particulate matter ($PM_{2.5}$), hydrogen sulfide, and silica dust, hydrogen sulfide, and silica dust (3, 8-12); and

Climate Change

WHEREAS, various activities associated with fracking have been demonstrated to generate emissions including methane which would likely undermine efforts by California to reduce global warming gas emissions to 1990 levels by 2020 (13-16); and

WHEREAS, all activities associated with oil and gas production enabled by hydraulic fracturing or acid stimulation can bring about indirect impacts, whether or not the wells are stimulated (3); and

Seismic activity

WHEREAS, an increase in hydraulic fracturing activity and expanded production in California could increase the seismic hazard from wastewater disposal (3); and

WHEREAS, given that fracking has been responsible for earthquakes in Oklahoma, Texas, Ohio, and Colorado which are less accustom to earthquakes and given California's geological context, and thousands of fault lines some of which are near oil and gas extraction sites, it is important to understand how the oil and gas extraction may impact seismicity and induced earthquakes (3, 17); and

Wildlife

WHEREAS, Fracking comes with industrial development that displace and pose a serious risk to California wildlife, many of which are endangered species native to areas where oil and gas extraction take place (3, 18, 26-28); and

Social &Health impacts/Setbacks

WHEREAS, well pad preparation, drilling, and well stimulation, as well as noise from trucks, generators, drilling operation, and pumps generate significant noise levels affecting neighboring residence, schools, and work place (5); and

WHEREAS, well stimulation activities occur during both daytime and nighttime hours. Light pollution has been reported as a nuisance and has been positively associated between indoor artificial light and poor health outcome. Further, other studies have suggested that nighttime light, exposure can disrupt circadian and neuroendocrine physiology (7, 33); and

WHEREAS, an increased crime, social disruptions, traffic accidents as well as accidents at well sites, pipelines, fires related to oil and gas extraction (5, 7, 8, 33); and

WHEREAS, the literature on oil and gas suggest that the closer a population is to active oil and gas development, the more elevated the exposure, primarily to air pollutants but also water pollutants

WHEREAS, oil and gas wells are concentrated in communities of color and those vulnerable to pollution (2, 5); and

Poor regulations

WHEREAS, Fracking is poorly regulated by states and exempted from provisions of 7 major environmental laws including the Federal Safe Drinking Water Act of 2005
leaving it to individual states to create laws and regulations of their own (23-25); and

Bann

WHEREAS, in recognition of unresolved environmental and public health numerous cities, states, and countries have banned or issued moratorium on fracking and waste water disposal (31, 32); and

WHEREAS, all activities associated with oil and gas production enabled by hydraulic fracturing or acid stimulation can bring about indirect impacts, whether or not the wells are stimulated (3); and

RESOLVED, That the **<< name of organization>>** favors legislation that requires the full disclosure of chemical used for **<<fracking and other unconventional extraction>> << oil and gas extraction>>**, including disclosure of the specific chemicals and wastewater injected, quantities and location; and be it further;

RESOLVED, That the **<< name of organization>>** favors legislation that requires the State of California to record and monitor **<<fracking and other unconventional extraction>> << oil**

and gas extraction>>, data, to monitor for human [and animal] exposures, and to share this information with the physicians, and the public, and be it further;

RESOLVED, That the **<< name of organization>>** favors legislation that supports research into the public health impacts of**<<fracking and other unconventional extraction>> << oil and gas extraction>>**, and production in California; and be it further;

RESOLVED, That the **<< name of organization>>** favors measures to educate physicians and other public health professionals concerning the potential health and environmental effects resulting from**<<fracking and other unconventional extraction>> << oil and gas extraction>>**; and be it further;

RESOLVED, That the **<< name of organization>>** favors measures for the oil and gas industry to fund coordinated research on the health, environmental and social impacts of **<<fracking and other unconventional extraction>> << oil and gas extraction>>**, that will lead to potential strategies to mitigate these impacts, particularly on vulnerable populations; and be it further;

RESOLVED, That the **<< name of organization>>** favors federal, state, local and tribal government agencies to perform Health Impact Assessments (HIAs) prior to new **<<fracking and other unconventional extraction>> << oil and gas extraction>>**, projects; and be it further;

RESOLVED, That the **<< name of organization>>** favors policy regulations for safe and proper disposal of drilling fluids and waste resulting from **<<fracking and other unconventional extraction>> << oil and gas extraction>>**,

RESOLVED, That the **<< name of organization>>** favors measures for public health professionals from federal, state, and local government to be involved in the decision making process, including policymaking, managing, and monitoring the oil and gas industry in California; and be it further;

RESOLVED, That the **<< name of organization>>** favors federal and state policy changes that close the existing "loopholes" that exempt **<<fracking and other unconventional extraction>> << oil and gas extraction>>**, from environmental regulations and public health laws, including the Clean Water Act, Clean Air Act, and hazardous waste law; and be it further;

BEST

RESOLVED, That the **<< name of organization>>** advocates for the establishment of an industry-funded, independently arbitrated state trust fund for people that my harmed as a result of **<<fracking and other unconventional extraction>> << oil and gas extraction>>**, and be it further;

RESOLVED, That the **<< name of organization>>** favors policy change that established setbacks on existing **<<fracking and other unconventional extraction>> << oil and gas extraction>>**; and be it further;

RESOLVED, That the **<< name of organization>>** supports legislation that calls for a state moratorium on new oil and gas fracturing extraction until human and ecological safety can be supported by scientific study; and be it further;

RESOLVED, That the **<< name of organization>>** supports legislation that calls for a state ban on fracking

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California Specific Fact Sheet for Health Professional

New technologies have enabled fracking and other unconventional well stimulation techniques to extract oil and gas from domestic geologic formations of low permeability (e.g. shale) that were once too expensive to exploit. Many fail to evaluate the full multi-step process of fracking and other unconventional oil and gas extraction and the impact it oil extraction has on our climate, water, air, and health.

The oil and gas industry say that oil and gas extraction is safe, however the state's only independent study released by California Council on Science and Technology (CCST) on July 2015, notes a number of potential health and environmental impacts of well stimulation on human health in California. The CCST study notes the toxicity and biodegradability of more than half the chemicals used in hydraulic fracturing remains uninvestigated, unmeasured, and unknown. [16]

What is Fracking and Other Unconventional Oil and Gas Extraction in California?

Fracking and well stimulation differs in California from other states because of the state's natural geology of petroleum reservoirs. Chemical use, depth of wells, and volume of water use are some of the key differences in fracking and well stimulation in California.

The General California Process:

- Step 1: Identify location
- Step 2: Drill a well ~2,000 ft deep
- Step 3: Pump thousands of gallons of water, sand, and chemicals at high pressure to create fissure that frack the shale rock
- Step 4: The fissures release the trapped oil and natural gas
- Step 5: Buoyancy allows the oil and gas to flow back up the well to the surface
- Step 6: Once at the surface, the oil and gas is processed, refined and shipped to the market.

Image source: 23

What Chemicals are used during the Process?

In California, hundreds of chemical additives, such as strong acids, strong bases, silica, biocides, quaternary ammonium compounds, have been voluntarily disclosed to be in use by oil and gas operators. [1.] Of the known chemicals being used, many are known carcinogens, endocrine disruptors, reproductive and neuro toxins. Over 100 chemicals are reported as "trade secrets" and therefore, the exact quantity, toxicity, and bioaccumulation properties of these chemicals remain unknown. [15] The lack of transparency makes it difficult to assess the public health risks posed by many of the stimulation chemicals used. Abiding by the Precautionary Principle, physicians and public health professionals should call for a halt on the use of unknown chemicals during fracking and other unconventional oil and gas extraction, until further research evaluates their health and environmental safety.

How is California Water Affected by the Process?

Fracking and other unconventional oil and gas extraction can result in the release of contaminants into the environment, including into surface water and groundwater. The following are water contamination mechanisms:

- Surface spills [16]
- Well casing failures [17]
- Migration of fluids [18]
- Improper handling of waste [19]

Spills and leaks during chemical transport, storage, mixing, well stimulation, well operation and production, wastewater storage, treatment and disposal[2].

For every barrel of oil produced, up to 10 barrels of waste water (also referred to as produced water), is returned to the surface along with oil and gas.[15] The contaminated produced water and flowback water, contain chemical additives used in the stimulation process, as well as compounds that may have formed due to the transformation, degradation, or reaction between the chemical additives. In addition, produced water and flow back water pulled up from the ground, can contain a variety of compounds including heavy metals such as lead and arsenic or radioactive compounds that naturally occur in the soil, and residual oil and gas[3].

In California, 60% of produced and flowback water is disposed of in unlined pits or sumps. Such fluids have the potential to seep into the ground and contaminate surface or groundwater[4]. Recovered fluid, which is fluid returned to the surface before production even begins, is often mixed with water to dilute its content and stored in tanks at the well site prior to reuse or disposal[5]. 99% of these fluids are injected into underground Class II disposal wells. Injection wells are classified according to the location and type of fluid injected. [13] According to the US EPA, Class II wells are used to inject brines and other fluids associated with oil and gas production. [14] Numerous disposal wells are located near active faults resulting in a great concern for induced seismic activity and the aftermath that can result[6]. With water being a scarce resource, the reuse of produced water for agriculture, particularly for irrigation raises concerns because the variety of chemicals used that may end up in the water and crops is unknown.

Air Pollution

Fracking and other unconventional oil and gas extraction have the potential to emit greenhouse gases (GHGs), as well as volatile organic compounds (VOCs), nitrous oxides (NOx), toxic air contaminants (TACs) and particulate matter (PM); all of which contaminate the air, and increase the risks of health impacts associated with poor quality.

On average 140,000 gallons of water are used per fracking operation. [20] Diesel trucks along with the machinery used to pump the chemicals and water into the well, are great contributors of NOx and particulate matter.[24] Particulate matter is known to increase the incidence of asthma, cardiovascular disease, chronic obstructive pulmonary disease, and premature death as well as of cancer and infant mortality. [24] Venting as well as the flaring of waste gas results in methane, VOCs and TACs emissions that contribute to poor air quality. Consequently, poor air quality contributes to respiratory illnesses such as reduced lung function, asthma and emphysema. Pregnant women, children, and the elderly are the most vulnerable to air pollution

Literature suggests that the primary TACs exposure risk factors associated with oil and gas development is geographic proximity to active oil development[7,8]. This is of great concern in California since half a million people, live within one mile of a well that has been fracked or stimulated.[10] Over 61, 000 children attend school within one mile of a stimulated oil or gas well.[10] Children attending school at such a close proximity are exposed to high levels of air toxins, such as benzene, toluene, ethyl benzene, xylene (BTEX) other VOCs, and acids such as Hydrogen Sulfide which may have serious impacts on their social, emotional and physical health. [21]

The recent boom in fracking and well stimulation techniques negatively impacts the health of Californians and hinders the state's efforts to fight climate change. Methane is release into the air along with other air pollutants. Methane is a highly potent greenhouse gas. Methane is 72 times more effective at trapping heat than carbon dioxide over a 20 year period.[11] This could have negative impacts on climate change and indirect effect on our overall health, wellbeing, and agriculture production.

Exempt from Regulations that protect the Public's Health

Regulatory exemptions have favored the oil and gas industry without considering the health and environmental impacts on Californians and future generations. In 2005, the Energy Policy Act exempted the natural gas and oil industry from seven major federal laws including the Safe Drinking Water Act and Clean Air Act, which were designed to protect public health.[12] In September 2013, Governor Brown signed Senate Bill 4 (SB4) with the intent to establish a regulatory program for oil and gas well stimulation treatments. SB4 required the Division of Oil, Gas and Geothermal Resources (DOGGR) to prepare an Environmental Impact Report and mandated an independent scientific study to be completed as well as the implementation of regulations. However, the implementation of the

regulations was set in place before the independent scientific study reached any conclusions as to the public health impacts. The independent study has identified a number of issues that has sufficient data and evidence to identify them as risk factors that could endanger human health. [22]

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