Summary: Animals as Sentinels for Public Health Risks from Oil and Gas Development

Why study animals to determine human health risks?

- Animal sentinels are animal species who are monitored to provide advance warning of risks to humans of infectious disease or other harmful agents present in the environment.

- The use of animal sentinels has historical precedent. For example, caged canaries used in coal mines in the early 1900s were more sensitive to, and affected by, the presence of carbon monoxide and other dangerous gases.

- Animals can have geographical and temporal overlap with human populations, with similar routes of exposure (breathing, eating, drinking and skin absorption). Animals are more likely to inadvertently consume contaminated water and feed and may be more restricted in movement from a contaminated environment.

- Shorter lifespans and more frequent reproductive cycles allow for timely evaluation of morbidity or mortality.

- Relevant health outcomes (e.g., cancers, reproductive effects) can occur before such effects are seen in humans.

How can animals inform us of public health risks from oil and gas production?

- Wild and domestic animals, like humans, can reside close to oil and gas production sites, and in turn, be affected by such associated hazards as air and water pollution.

- Hazards related to oil and gas production, which can affect both animals and people are: physical disruption (e.g., noise and seismic activity); toxic components of petroleum and gas products (e.g., poly-aromatic hydrocarbons [PAH]); and specific chemicals used in drilling and hydraulic fracturing.

- Human ethical concerns prohibit experimental protocols such as random assignment to known contaminants.

What is known?

- There is no single "right" sentinel species or specific lesion (tissue abnormality) to track the effects from oil and gas industry exposures. The risk settings are variable and complex and animals differ greatly in their response to the various contaminants involved.

- The scientific literature associating pathological changes in animals to exposures from the oil and gas industry is relatively sparse and not consistent. Examples of positive findings related to exposures attributed to the oil and gas industry are given below:

  - *Crude oil* – acute laboratory exposure caused pulmonary inflammation in hamsters; chronic experimental exposure affected viability of pink salmon eggs and resulted in decreased body mass and hematological effects in otters (also observed in surveillance data); in kittiwakes (birds) there was a decreased annual return and laboratory diagnoses of anemia.

  - *Oil sands industry exposures* – acute experimental exposure showed hormonal effects on goldfish; with chronic experimental exposure, yellow perch developed white tumor-like growths on their fins and wood frogs had incomplete metamorphosis.

  - *Sour gas* – surveillance data generally showed no reproductive effects, although an exception was a study showing an association with calf mortality.

  - *Shale Gas production wastewater* – a review cited cases of stillbirth and abortion in exposed cattle.

- Toxicological effects observed in various mammals associated with crude oil, refined petroleum products or individual PAHs include altered DNA, hematological effects, hepatic or renal effects, impaired reproduction, neoplasia, altered behavior, and death.

Challenges in research and implementation

- Further research is needed to study exposure-response relationships and interactions of multiple oil and gas contaminants on the health of animals.

- Sentinel animals and types of lesions have not yet been identified that would provide specific and reliable data to allow extrapolation to human health risk assessment endeavors.

- There is little evidence of effects on animals under realistic conditions of chronic exposures, as opposed to laboratory or acute exposures. At question is whether laboratory findings of exposure to specific oil and gas contaminants relate to exposure conditions outside of experimental settings.

- Animal sentinels have the potential for early detection of public health hazards associated with the oil and gas industry if a coordinated and integrative surveillance system is developed and maintained. Ongoing research is needed to design reliable and meaningful surveillance and monitoring, particularly for cumulative effects.

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