



Medical Officer of Health

REPORT TO THE BOARD

Friday, January 21, 2011

Industrial Wind Turbines

Ontario Public Health Standards - Health Hazard.

The *Ontario Public Health Standards 2008* establishes the responsibility of the Board of Health regarding Health Hazard Prevention and Management. The Board of Health outcomes identified in the standards are:

- The Board achieves timely and effective detection and identification of exposures of human health concern and associated public health risks, trends and illnesses.
- The Board of Health is aware of and uses epidemiology to influence the development of healthy public policy and its programs and services to reduce or eliminate the burden of illness from health hazards in the environment.
- The public is aware of health protection and prevention activities related to health hazards and conditions that create health hazards.
- Community partners have the information necessary to create healthy public policies related to reducing exposure to health hazards.
- The public and community partner are aware of health hazard incidents and risks in a timely manner.

Also provided with the standards is a protocol for identifying, investigating and managing health hazards:

4) Health hazard prevention and management

- a) In collaboration with the lead government agencies with primary responsibility for the environmental health issue and/or other relevant agencies, experts and interested parties as applicable, the Board of Health shall manage identified health hazards in the environment by:
 - i) Developing options and implementing action plans, including strategies for corrective actions for controlling and where possible mitigation exposure, based on a risk assessment approach. These options many include healthy public policy;

- ii) Developing and implementing risk communication strategies for the public and stakeholders specific to the environmental health issues;
- iii) Providing educational material and/or information to the public about health hazards in the environment and actions to minimize the hazards and/or reduce exposure;
- iv) Monitoring corrective actions pertaining to identified health hazards in the environment; and
- v) Addressing non-compliance with the *Health Protection and Promotion Act* and taking action where appropriate.

Definition of a health hazard in the environment: Health hazards in the physical environment that are not addressed in other programs under the *Ontario Public Health Standards*.

Health Hazard and Industrial Wind Turbines

There is considerable debate among my colleagues and in the wider community on the issue of whether exposure to Industrial Wind Turbines is a factor that could be considered a health hazard. To this discussion, I would put forward that smoking, alcohol misuse, obesity and social inequity are much more critical health hazards in our community that affect many more people to a much greater degree. Also of note, while the presence of an Industrial Wind Turbine is considered by some as a stress factor, it should also be acknowledged that stressful situations are part of life and public health cannot be expected to mitigate every stressful exposure.

It should be identified that the lead ministries regarding this issue are the Ministry of the Environment and Ministry of Energy and Infrastructure.

There are some key themes that have come forward in my research and I borrow these, paraphrased from the *Acoustic Ecology Institute Spotlight Report Wind Farm Noise: 2009 in Review*.

1. It is clear that many people, in many different parts of Grey Bruce and Southwestern Ontario have been dramatically impacted by the noise and proximity of wind farms. To dismiss all these people as eccentric, unusual, or as hyper-sensitive social outliers, does a disservice to constructive public discourse and short circuits our opportunities to learn and benefit from their experiences as we continue to develop new wind farms.
2. It is also clear that wind farm noise is really not that bothersome to most people who hear it or live near it. Worldwide, the majority of wind developments do not generate substantial ongoing noise issues. Concerns that dominate public discourse and activist web sites tend towards issues that are hard to quantify such as direct health effects, especially of low frequency noise, and often attempt to inflate the extent of problems. In particular, communities that may be considering new wind developments are targets for this discussion.
3. The nature of the sounds made by wind turbines make it especially difficult to rely on reassuring “noise limits”. Noise propagation varies greatly with changing wind and

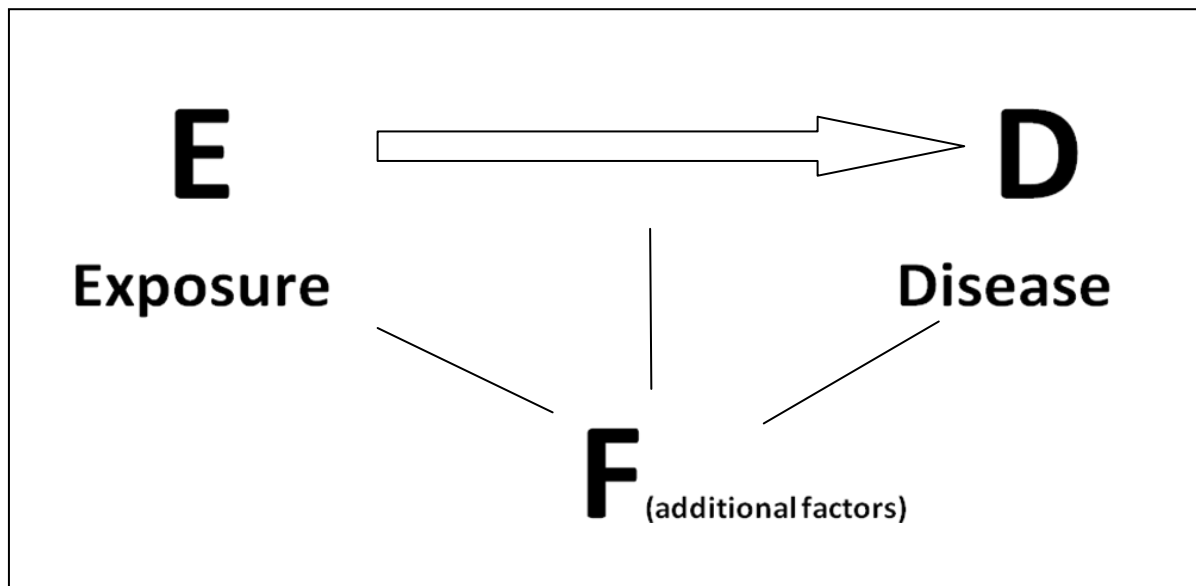
atmospheric conditions. Average noise recordings are not consistently measured or reported. The pulsing nature of turbine noise is inherently more forceful and more disruptive than traffic or industrial noises. More research is needed to learn about the factors that create the most troublesome turbine noises such as pulses and low frequency sound.

4. Communities and individuals are facing difficult social choices. Many broad brush studies attempting to cover all situations, conditions or instances simply dismiss the cause-effect between wind farm noise and various measures of impact including health, annoyance and reduced property values. It is apparent that a minority of those people living or situated near Industrial Wind Turbines may experience dramatic, negative impacts. We cannot pretend this affected minority doesn't exist. A determination has to be made as to what level or extent of negative impacts is tolerable. To all intents and purposes, how many such affected neighbors are we willing to accept? Decisions are needed, if and to what extent, wind farm planning and operations are to be adapted in response to these impacts.

Primer on Proof of Causation.

It is a challenge to organize the information, and to some degree lack of information, regarding the possible hazard of wind turbine technology being introduced in communities. It can be broken down into two main risk domains: the technical and the sociological. What follows are some brief comments on both areas and ideas regarding areas of possible study.

Studies undertaken to demonstrate the link or association between exposure (in this case wind turbines) and disease must also look beyond this relationship, as it is influenced by many additional factors. These other factors can be predisposing such as age, gender, marital status, education; enabling factors of income, health insurance coverage, nutrition; precipitating factors for example exposure to disease, organism, noxious agent; or reinforcing factors that can include repeated exposures, incentives/disincentives. It looks something like this:



Sir Bradford Hill established nine criteria for assessing evidence of causation; does Exposure (wind turbine technology) cause Disorder (symptoms that people are experiencing). These criteria are helpful in answering the basic question '*Is there another explanation for this other than cause and effect?*'.

1. Strength of association
2. Consistency of association
3. Specificity
4. Temporal relationship
5. Biological gradient
6. Biological plausibility
7. Coherence
8. Experimental evidence
9. Reasoning by analogy

1. **The strength of the association.** To reasonably assess the association of human symptoms and functioning turbines we must be able to characterize and accurately measure the hazard. Functioning wind turbines produce audible noise, infrasound, electrical flow and connections with the resultant electromagnetic fields, light flicker, occasional ice scatter and possibly other effects such as changes to wind or weather patterns. The technology itself, including design and size of the turbine, the speed and direction of the wind and other atmospheric conditions will alter all of these exposures. There is also evidence that the topography, siting, set-back distances and the geology may also affect the exposure. Presently there is poor or non-existent characterization of the known hazards and thus poor or non-existent exposure assessment. It is not clear who is most at risk from any of the suspected effects. It is difficult to isolate some of the specific exposure factors from what may be more universal risks such as stress etc. Epidemiology is the study of health outcomes in people and is thus the only science that can directly inform us about actual health risks from real world exposures. Epidemiological research tries to determine if an association exists between exposures and outcomes, assesses if it is causal and what can be done to reverse or mitigate it. Epidemiological studies that attempt to show causal association between exposure and effect are hard to design and execute. The results are often inconclusive and the studies are invariably expensive. The strength of association criteria requires significant rigor to separate out the factors in order to successfully measure and assess their affect on a population. Consolidation of information from different locations and different fields of study would be useful.
2. **Consistency of findings.** Are there many studies across different populations, circumstances, and study designs? There is a consistency in the literature of symptoms reported by people exposed to functioning wind turbines. Case series from many different countries and continents describe similar health complaints.
3. **Specificity.** Does exposure lead to clearly definable characteristic effects? This needs to be studied as the various hypothesized exposures are measured and modeled. Presently the symptoms reported, such as sleep disturbance, headaches, dizziness, tinnitus, ear pressure and so on, are common in the general population and are subjective in nature. There are

some validated questionnaires developed to assess changes in some of these symptoms and others are being developed. Hypertension is being monitored in some studies and there is some research underway to assess levels of the stress hormone cortisol in exposed and non-exposed people. Since many of the symptoms are common to many different types of exposure this is a difficult set of criteria to measure with a high degree of confidence.

4. **Temporal relationship**. Exposure must always precede the disorder. Many of the core symptoms reported with respect to Industrial Wind Turbines exposure are also reported by people not exposed to Industrial Wind Turbines. Additionally many symptoms were experienced by people before, as well as after, the exposure. A more precise ability to assess sleep disturbance, or for some of the other equally subjective symptoms, may allow an opportunity to show a temporal link between exposure and symptom. There are many case studies and published accounts where people describe symptoms only when the turbines are operating or when the wind is from a certain direction; and conversely a lessening of symptoms when the individual is physically removed from the exposure or the turbines are not producing power.
5. **Biological gradient**. This refers to a dose-response pattern. Is a person that has greater exposure more likely to experience symptoms than someone with less exposure? Epidemiological surveys have been undertaken and ongoing studies continue to demonstrate that people living closer to an Industrial Wind Turbine development experience a greater number and more severe symptoms than people living farther away. These surveys do not try to characterize the possible exposures but take the Industrial Wind Turbine development as a whole entity. A demonstrated and predictable biological gradient is useful. This information could be used to mitigate the effects on people from Industrial Wind Turbines until a more complete hazard characterization has been developed.
6. **Biological plausibility**. In other words based on our current knowledge, do we know of biological mechanisms that could cause the outcome observed from the exposures? This is an interesting question and an area of debate regarding cause and effect. If someone responds to stress with sleep disturbance, headaches, irritability, dizziness, etc., and the stress response is caused by an environmental exposure, is the health effect caused by the environmental exposure or the stress response to the exposure? As a physician, I do not think the direct or indirect cause is a particularly useful determination to the person suffering. However, it does make a difference in how a person might mitigate the problem and become healthier. There is a body of scientific comment and research to suggest, that in some people, there may be a direct causal pathway from the broad-band acoustic production of the turbine to middle ear dysfunction leading to sleep disturbance and other symptoms. A full understanding of this possibility needs to be quantified in the population.
7. **Coherence**. Does the evidence fit with what is known regarding the natural history and biology of the outcome? This factor is difficult to apply with a relatively new and poorly characterized exposure. However, there were some animal and human studies with infrasound exposures carried out in the 1960's with a military/weapon development initiative that considered infrasound as a possible threat. Most people are not conscious of exposure to infrasound but most mammals have a physiological response when exposed. More information is needed in this area.

8. **Experimental evidence.** If an observed association is true, then it can lend itself to experimental manipulation; the response can be altered so that some preventive action can be taken. Once again, only some of the possible exposures have been examined and some experimental data is available but more information is needed.
9. **Reasoning by analogy.** The observed association is supported by similar associations in different locations where Industrial Wind Turbines have been introduced. There is evidence in a number of animals to support a hypothesis that some people respond to infrasound with increased alertness and a sense of unease.

Gathering More Information

There is a huge amount of information accumulating regarding wind turbines, environmental noise and the effect on human health. There are international conferences and symposia, and numerous journals with publications on topics related to the wind turbine and human interface. Likewise, the acoustics and technology sector is also producing a lot of new information. However, there are some areas that further exploration and research would be useful.

1. Determining the prevalence of susceptibility - what portion of exposed people suffers distress? To get this type of information it would be necessary to systematically collect information from all exposed subjects rather than relying only on those that volunteer or report disruption. This would require working with the industry to get accurate, statistically significant samples, with appropriate sized populations. This may require amending lease contracts the industry has with land owners with regard to the sharing details of the health effects from an installation. It can be expensive to carry out this type of epidemiological research with enough size and specificity of study protocol to achieve significant results, separate the effect of hypothesized factors and allow comparisons between populations of exposed and non-exposed people.
2. Comparisons of the prevalence of susceptibility between various Industrial Wind Turbine technologies, designs, size and siting. This would advance best practices to address and mitigate negative impacts on people living nearby these installations.
3. Improving field measurement of the broad band noise including low frequency noise. Ideally, this should be done in diverse geographic and topographic situations, various types of housing, with different wind speeds and directions, with varied atmospheric and temperature conditions and different sized turbines. Better models could then be developed using real data rather than relying on averages and estimates.
4. Finding a biomarker for susceptible individuals. By recognizing their sensitivity and taking appropriate action, susceptible individuals would be able to avoid exposure and the resulting suffering.
5. Collecting econometric data to assess the real costs of the new technology. This would include the cost to the individuals affected; the cost to build and install; the expected benefit in dollars not 'green points'; loss or gain of property value; loss of agricultural potential and recreational appeal; tax gain were municipalities able to zone and plan for the new industry and conversely the tax loss to municipalities not presently able to benefit from the land use changes in their jurisdictions.

6. Examining technological changes in design, operation and maintenance of Industrial Wind Turbine installations specifically to reduce the noise and impact on residents.
7. Community and social research to determine the best way to introduce new technology (Industrial Wind Turbines and others) to a variety of communities so that the community and social disruption is lessened. For example, it is not accurate or realistic to compare the rural and recreational communities such as Grey Bruce to large cities or very remote areas. The value Grey Bruce residents place on clean air and water, quiet enjoyment of their property and a natural visual vista are different than the values placed on those same amenities in an urban area or the far North.
8. Looking at what specific community research and consultation should be undertaken before installation of an Industrial Wind Turbine development in order to avoid increasing the community 'poverty gap'. This includes developing measures to ensure that everyone in the community can tolerate the new technology and all will benefit.

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