

To:

Dr Steve Hambleton
President, Australian Medical Association
president@ama.com.au

March 18, 2014

Dear Dr. Hambleton,

Re: Adverse Health Effects and Industrial Wind Energy Facilities

I am aware of the Australian Medical Association position (2014) regarding risk of health associated with industrial wind turbines. As background, I am an independent, full time volunteer and published researcher regarding health effects and industrial wind energy facilities and share information with communities, individuals, authorities, wind energy developers, the industry and others.

I am a co-author of three articles, one a review, published in Canadian rural medical journals, *Can J Rural Med* 2014;19(1); *Can Fam Physician* 2013; 59: 473-475 (Commentary); and *Can Fam Physician Vol 59: 921-925 Letters / Correspondence*. These are cited in PubMed and are attached for your information.

I am taking the opportunity to share the experiences regarding the negative effects which can occur when industrial wind energy facilities are sited in close proximity to family homes and sensitive environments; and to provide some of the peer reviewed and other evidence regarding this topic. [See Appendix I for additional details. Appendix II briefly lists Krogh publications – author/coauthor.].

Personal disclosure: I declare no potential conflicts of interest and have received no financial support with respect to the research and authorship of this overview. This commentary is public and may be shared.

I have made a number of submissions to both provincial and federal authorities in Canada and shared information internationally. An example is one sent to the Minister of Health, Health Canada regarding risks to children. This is public and may be shared.

This is a complex and challenging topic. The many variables associated with wind energy facilities such as siting design and proximity, wind direction and speed, terrain, house construction, a variety of noise emissions, electrical pollution to name a few and individual response, can affect the assortment and description of symptoms being reported.

To assist with this topic, some examples of comments received from those reporting adverse health issues are listed below:

- § When individuals visited their family physician, some comment they felt there was a lack of understanding of the effects associated with the wind energy facilities. They sensed disbelief that they were being harmed by these facilities.
- § Some comment on an inability to adequately articulate or describe the physical and other sensations being experienced.
- § Some feel they were characterized as being jealous and/or resentful because they weren't receiving economic benefits and/or they didn't like the look of the turbines, and/or they were anti-wind or against green energy.
- § A few comment that their family physician declined the peer reviewed and other references offered.
- § Some report they were given medication to treat their sleep disturbance, anxiety, stress, depression, nausea, vertigo, migraine/headaches, chest sensations, palpitations, joint pain, exhaustion and other symptoms. Some report the medication did not solve the issues as the source i.e. the wind energy facilities, were still operating in close proximity to their homes.
- § Some report that in their attempt to sleep, alcohol was taken with a sleep aid and that as time went on, more alcohol and extra doses of the sleep aid were required in order to fall asleep and/or remain asleep.
- § In some cases, some report their symptoms were attributed as NOCEBO effects and they were imagining it or it was all in their heads and this was what was making them ill.
- § Some report a feeling of being dismissed/discounted. This caused them additional pain, hurt, grief and a sense of being doubted. Some report that they decided to not describe the full extent of their symptoms and are reluctant to share further information with their physician.

Of concern is that some report they are hesitant to elaborate on the degradation in their quality of life, the significant changes to their living environment, the negative changes in their health status, and the social-economic impacts. This reluctance could deprive the family physician of information relating to disruptive noise levels, vibration, pulsation and other and the associated symptoms.

These comments could have significant ramifications as in some cases, the family physician may not be receiving all the facts which could hamper or misdirect the clinical investigation.

The role of the physician as a health advocate in Canada ^{1, 2, 3, 4, 5} is known to many health care professionals.

There is sufficient evidence that some are negatively affected by industrial wind energy facilities. Some families exposed to these facilities are abandoning their homes and reporting health and social-economic harm including loss of property value.^{6, 7, 8, 9, 10}

Jeffery, Krogh and Horner (2014) in Can J Rural Med 2014;19(1), a publication of the Canadian Medical Association concludes:

“Health is one of the fundamental rights of every human being. Some people exposed to IWTs experience negative effects to their physical, mental and social well-being. There is sufficient evidence to support the hypothesis of Colby and colleagues that documented symptoms can result from annoyance to audible IWTs. Amplitude modulation of IWTs, audible LFN, and tonal, impulse and nighttime noise can contribute to annoyance and other effects on health. In addition, there is emerging evidence that suggests inaudible LFN or infrasound from IWTs may result in negative health effects.

Further research is required to clarify the exact role that sound characteristics, visual impacts, stray voltage and socioeconomic impacts of IWTs may have on human health. As more IWTs are installed, rural physicians are likely to be presented with increasing numbers of patients who are adversely affected. Based on current knowledge, we expect that, at typical setback distances and sound pressure levels of IWTs in Ontario, a nontrivial percentage of exposed people will be adversely affected. “Trade-offs” of health for perceived benefit in alternate forms of energy can be prevented if setback distances and noise limits are developed using established noise management techniques. In addition to providing care for affected patients, rural physicians have a responsibility to advance understanding and to help inform IWT regulations that will protect the physical, mental and social well-being of patients.”¹¹

The potential for industrial wind turbines to harm humans is stated in an Ontario Environmental Review Tribunal (ERT) Decision, July 18, 2011 which involved 26 expert witnesses from around the world. The Tribunal was conducted under oath:

“This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.”¹²

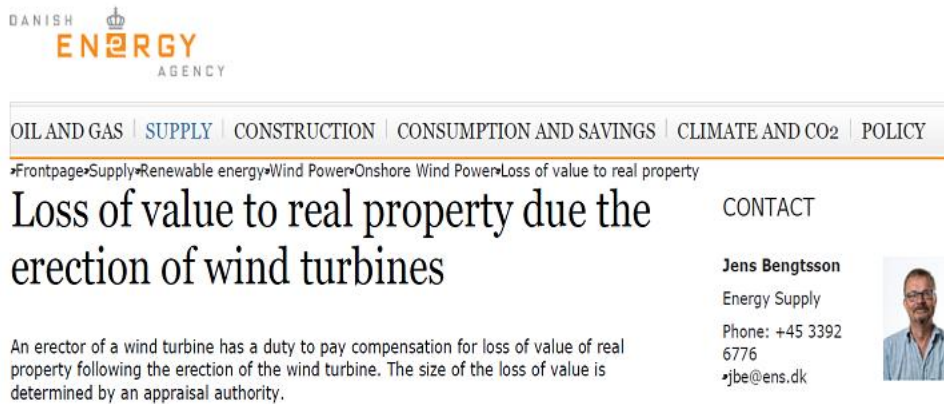
In 2013, research funded by the Ontario Ministry of the Environment indicates statistically significant relationship with distance and sleep disturbance, vertigo and tinnitus.¹³

Regarding social implication and property values, Counsel for the Ministry of Environment, Ontario, Canada states:

“...it’s the social implications where people are complaining on web sites about how their property values have gone down.”¹⁴

“We will see in the course of this hearing that lots of people are worried about windmills. They may not like the noise, they may think the noise makes them sick, but really what makes them sick is just the windmills being on the land because it does impact their property values. That’s what makes them sick is that, you know, they’ll get less money for their properties, and that’s what’s causing all this annoyance and frustration and all of that.”¹⁵

In Denmark, an erector of a wind turbine has a duty to pay compensation for loss of value of real property:¹⁶



The screenshot shows the Danish Energy Agency website. The logo at the top left reads "DANISH ENERGY AGENCY". A navigation bar contains links for "OIL AND GAS", "SUPPLY", "CONSTRUCTION", "CONSUMPTION AND SAVINGS", "CLIMATE AND CO2", and "POLICY". Below the navigation bar is a breadcrumb trail: "Frontpage > Supply > Renewable energy > Wind Power > Onshore Wind Power > Loss of value to real property". The main article title is "Loss of value to real property due the erection of wind turbines". To the right of the title is a "CONTACT" section for Jens Bengtsson, Energy Supply, with phone number +45 3392 6776 and email jbe@ens.dk. A small portrait photo of Jens Bengtsson is also visible. Below the title, a short summary states: "An erector of a wind turbine has a duty to pay compensation for loss of value of real property following the erection of the wind turbine. The size of the loss of value is determined by an appraisal authority."

The Ontario Real Estate Association requires seller disclosure:

“Are there any hydro generating projects planned for the immediate area? eg: Wind Turbines.”¹⁷

Lansink (2013)¹⁸ and DeLacy and McCann (2012)¹⁹ have documented loss of property value relating to siting of wind energy facilities.

On July 16, 2013, the Honourable Rona Ambrose was appointed the Hon. Minister of Health of Health Canada. Prior to this appointment, correspondence dated June 30 2009 states:

“Health Canada provides advice on the health effect of noise and low-frequency electric and magnetic fields from proposed wind turbine projects, particularly for environmental assessments done under the Canadian Environmental Assessment Act. To date, their examination of the scientific literature on wind turbine noise is that the only health effect conclusively demonstrated from exposure to wind turbine noise is an increase of self-reported general annoyance and complaints (i.e., headaches, nausea, tinnitus, vertigo).”²⁰

The World Health Organization indicates risks from noise in general to the unborn, pregnant women, children, the elderly, occupational workers and those with pre-existing medical conditions including vulnerable babies and children.²¹

Additional detail is provided in the Appendix below.

I trust the information provided in this brief overview will assist with enhancing knowledge relating to the human and environmental health issues and the social-economic impacts of wind energy facilities when projects are sited in close proximity to residents and wildlife. My goal is to achieve siting that protects human health and avoids negative environmental and social-economic impacts to rural communities.

If I can assist, please do not hesitate to contact me.

Yours truly,

Carmen Krogh, BScPharm
Ontario, Canada
carmen.krogh@gmail.com

APPENDIX 1

1. Executive Summary

There is sufficient evidence to support that some are negatively affected by industrial wind energy facilities cited in close proximity to their homes.

Some families exposed to wind energy facilities are abandoning their homes and reporting health and social-economic harm. Some are having difficulty selling their homes or achieving market value.

Symptoms and causation have been acknowledged through peer reviewed and published references, testimony under oath, and/or disclosure evidence and/or witness statements and through other references briefly summarized in the attachments provided.

There are risks to the unborn, pregnant women, children, the elderly, occupational workers and those with pre-existing medical conditions including vulnerable babies and children.

Action should be taken to resolve the reported health, environmental and social-economic issues to the satisfaction of those currently affected and to avoid risk of harm in the future.

2. The Symptoms

McMurtry (2011) former Dean of Medicine, University of Western Ontario and former Assistant Deputy Minister of the Population and Public Health Branch (Health Canada) in a peer reviewed reference, details the commonly reported symptoms:

“Third-order criteria (at least three of the following occur or worsen following the initiation of IWTs):

Otological and vestibular

- a) Tinnitus
- b) Dizziness
- c) Difficulties with balance
- d) Ear ache
- e) Nausea

Cognitive

- a) Difficulty in concentrating
- b) Problems with recall or difficulties with remembering significant information

Cardiovascular

- a) Hypertension
- b) Palpitations
- c) Enlarged heart (cardiomegaly)

Psychological

- a) Mood disorder, i.e., depression, anxiety
- b) Frustration
- c) Feelings of distress
- d) Anger

Regulatory Disorders

- a) Difficulty in diabetes control
- b) Onset of thyroid disorders or difficulty controlling hypo- or hyperthyroidism

Systemic

- a) Fatigue
- b) Sleepiness”²²

The authors of Colby et al (2009), prepared for the American Wind Energy Association and Canadian Wind Energy Association determined the documented “wind turbine syndrome“ symptoms (sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep are symptoms)“ are not new and have been published previously in the context of “annoyance”” and are the “well-known stress effects of exposure to noise”.²³

A review which the hypothesis that annoyance from audible IWTs is the cause of these adverse health effects concludes:

“There is sufficient evidence to support the conclusion that noise from audible IWTs is a potential cause of health effects. Inaudible low-frequency noise and infrasound from IWTs cannot be ruled out as plausible causes of health effects.”²⁴

Annoyance may seem of little consequence in everyday language; however, in terms of health, the term annoyance is acknowledged as an adverse health effect.^{25, 26, 27, 28}

The Colby et al, (2009) literature review comments on a causal link (through annoyance) to the reported adverse health effects and that: wind turbine sound/noise may cause annoyance [p. 5-3], stress [p. 4-3, 4-10] and sleep disturbance [p. 4-3], which may have other consequences [p. 4-3, 4-10].²⁹

Regarding noise induced annoyance the US Environmental Protection Agency states:

“...“annoyance” can have major consequences, primarily to one’s overall health.”³⁰

The World Health Organization acknowledges noise induced annoyance to be an adverse health effect.^{31, 32}

A World Health Organization study:

“...confirmed, on an epidemiological level, an increased health risk from chronic noise annoyance.”³³

Pedersen et al (2008) notes:

“Annoyance with wind turbine noise was associated with psychological distress, stress, difficulties to fall asleep and sleep interruption.”³⁴

Rideout et al (2010) note:

“Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA.”³⁵

A December 2010 report on low frequency noise commissioned by the Ontario Ministry of Environment and released December 2011 by the Ministry:

“The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a **non-trivial percentage** of persons being highly annoyed. As with sounds from many sources, research has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons. (*bold emphasis added*)

Stress symptoms associated with noise annoyance, and in particular low frequency annoyance, include sleep interference, headaches, poor concentration, mood swings...”³⁶

The peer reviewed health survey WindVOiCe (Wind Vigilance for Ontario Communities) documents the cluster of symptoms (Krogh et al, (2011)).³⁷ The full version of WindVOiCe is available on the Society for Wind Vigilance web site.³⁸

Krogh (2011) reports on the loss of social justice associated with the industrial wind turbine file.³⁹

The World Health Organization acknowledges the importance of social justice and states:

“Social justice is a matter of life and death. It affects the way people live, their consequent chance of illness, and their risk of premature death.” (2008, p. 3)⁴⁰

3. A Snapshot of Evidence [*Also see attached summary of references February 2014*]

This overview focuses on human health and is not intended to be exhaustive. Additional references are available.

In 1948, the World Health Organization (WHO) defined health and the fundamental rights of every human being:

CONSTITUTION OF THE WORLD HEALTH ORGANIZATION¹

THE STATES Parties to this Constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

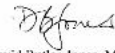
Many jurisdictions, including the Canadian federal, provincial, and territorial governments and health officials have accepted WHO’s definition of health (Health Canada, 2004, vol. 1, p. 1-1).⁴¹ I am not certain whether Ireland supports this definition.

Correspondence dated July 11, 2012 confirms that Canada, Health Canada and the Public Health Agency of Canada continue to support the WHO definition of health [*excerpted*]:

JUL 11 2012

Canada, including both Health Canada and the Public Health Agency of Canada, continues to support the definition of health established by the WHO's constitution in 1948: Health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

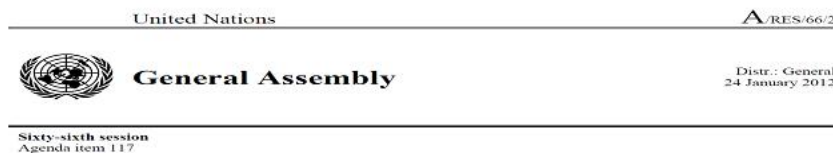
Sincerely,



David Butler-Jones, MD
MSc, CCFP, FRCPC, FACP

Canada

On January 24, 2012, the United Nations reaffirmed everyone's right to the enjoyment of the highest attainable standard of physical and mental health:



5. Reaffirm the right of everyone to the enjoyment of the highest attainable standard of physical and mental health;

The Victorian Civil Administrative Tribunal (2013) held in Australia states: ⁴²

"There is evidence before the Tribunal that a number of people living close to wind farms suffer deleterious health effects. The evidence is both direct and anecdotal. There is a uniformity of description of these effects across a number of wind farms, both in southeast Australia and North America. Residents complain of suffering sleep disturbance, feelings of anxiety upon awakening, headaches, pressure at the base of the neck and in the head and ears, nausea and loss of balance." [para116]

"In some cases the impacts have been of such gravity that residents have been forced to abandon their homes." [para117]

"On the basis of this evidence it is clear that some residents who live in close proximity to a wind farm experience the symptoms described, and that the experience is not simply imagined". [para118]

The above Tribunal comments about a causal link: ⁴³

"What is less clear is whether there is a causal link between sound pressure emissions from a wind farm and the health effects complained of." [para 119]

However, the Principle Investigator of the Health Canada Wind Turbine Noise Study states:

“...there is credible scientific support for an association between wind turbine noise and community annoyance.”⁴⁴

An Ontario, Canada, Environmental Review Tribunal Decision (2011) involving 26 expert witnesses from around the world who testified under oath states:

“This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.”⁴⁵

In addition, the Tribunal found:

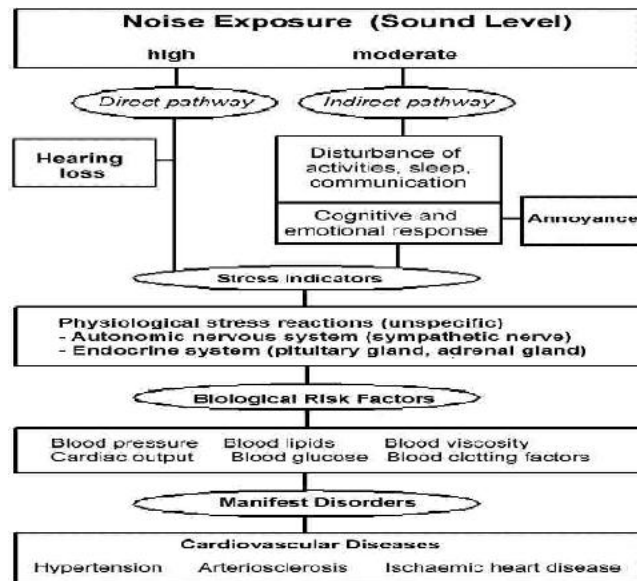
“... The Tribunal has found above that “serious harm to human health” includes both direct impacts (e.g., a passer-by being injured by a falling turbine blade or a person losing hearing) or indirect impacts (e.g., a person being exposed to noise and then exhibiting stress and developing other related symptoms). This approach is consistent with both the WHO definition of health and Canadian jurisprudence on the topic.”⁴⁶

The Ontario Environmental Review Tribunal expressed concerns with respect to *The Potential Health Impact of Wind Turbines (Chief Medical Officer of Health (CMOH) Ontario Report) – May 2010* and the need for further work on precaution:

“...about the Director’s apparent lack of consideration of indirect health effects and the need for further work on the MOE’s practice of precaution...”⁴⁷

The indirect pathway has been given a low priority regarding this topic. When one focuses on a "direct" effect one omits consideration of an equally significant part of the health equation i.e. indirect effects. The indirect pathway of noise annoyance, sleep disturbance and stress can lead to consequences such as cardiac issues.

The importance of the indirect pathway is illustrated through the noise schema below published by WHO.⁴⁸ [Reference: Noise Schema: World Health Organization, Night Noise Guidelines for Europe, 2009]



Testimony under oath during the Ontario, Canada Environmental Review Tribunal acknowledged that the indirect pathway was not considered by the CMOH (*The Potential Health Impact of Wind Turbines (Chief Medical Officer of Health (CMOH) Ontario Report) – May 2010*).⁴⁹

WHO (2009) discusses the impact of “disturbances of activities” and states:

“Physiological experiments on humans have shown that noise of a moderate level acts via an indirect pathway and has health outcomes similar to those caused by high noise exposures on the direct pathway. The indirect pathway starts with noise induced disturbances of activities such as communication or sleep.”⁵⁰

Peer reviewed research comments that wind energy was initially welcomed into communities (Krogh 2011;⁵¹ Shepherd et al 2011;⁵² Nissenbaum et al 2011.⁵³ For example, Shepherd et al (2011), Nissenbaum et al (2011) and Krogh et al (2011) are cited in a March 2012 peer reviewed editorial published in the British Medical Journal.⁵⁴

Nissenbaum et al. (2012) published a cross-sectional study involving two rural sites concluding:

“... that the noise emissions of IWTs disturbed the sleep and caused daytime sleepiness and impaired mental health in residents living within 1.4 km of the two IWT installations studied. Industrial wind turbine noise is a further source of environmental noise, with the potential to harm human health. Current regulations seem to be insufficient to adequately protect the human population living close to IWTs. Our research suggests that adverse effects are observed at distances even beyond 1 km.”⁵⁵

Jeffery, Krogh and Horner (2014) review states:

“Health is one of the fundamental rights of every human being. Some people exposed to IWTs experience negative effects to their physical, mental and social well-being. There is sufficient evidence to support the hypothesis of Colby and colleagues that documented symptoms can result from annoyance to audible IWTs. Amplitude modulation of IWTs, audible LFN, and tonal, impulse and nighttime noise can contribute to annoyance and other effects on health. In addition, there is emerging evidence that suggests inaudible LFN or infrasound from IWTs may result in negative health effects.

Further research is required to clarify the exact role that sound characteristics, visual impacts, stray voltage and socioeconomic impacts of IWTs may have on human health. As more IWTs are installed, rural physicians are likely to be presented with increasing numbers of patients who are adversely affected. Based on current knowledge, we expect that, at typical setback distances and sound pressure levels of IWTs in Ontario, a nontrivial percentage of exposed people will be adversely affected. “Trade-offs” of health for perceived benefit in alternate forms of energy can be prevented if setback distances and noise limits are developed using established noise management techniques. In addition to providing care for affected patients, rural physicians have a responsibility to advance understanding and to help inform IWT regulations that will protect the physical, mental and social well-being of patients.”⁵⁶

Jeffery, Krogh and Horner (May, 2013) published in *Canadian Family Physician*, the official journal for the College of Family Physicians of Canada concludes:

“Industrial wind turbines can harm human health if sited too close to residents. Harm can be avoided if IWTs are situated at an appropriate distance from humans. Owing to the lack of adequately protective siting guidelines, people exposed to IWTs can be expected to present to their family physicians in increasing numbers. The documented symptoms are usually stress disorder–type diseases acting via indirect pathways and can represent serious harm to human health. Family physicians are in a position to effectively recognize the ailments and provide an empathetic response. In addition, their contributions to clinical studies are urgently needed to clarify the relationship between IWT exposure and human health and to inform regulations that will protect physical, mental, and social well-being.”⁵⁷

A second reference in *Canadian Family Physician* by Jeffery, Krogh and Horner (September, 2013) states:

“The adverse health effects of audible and inaudible noise are substantial. Their effects are underestimated and underappreciated by some. We are guided by the references and the desire to safeguard the health and wellbeing of those living in the environs of IWTs. Harm can be avoided by placing IWTs at a protective distance

from residents. The acknowledgment that health effects occur in some is an important step toward achieving this goal.”⁵⁸

Ontario, Canada’s Wind Turbine Guidelines have a minimum setback of 550 meters and a 40 dBA noise study (predictive computer model). However, the approval of the wind facility allows up to 51 dBA with increased wind speeds.

An Ontario, Canada, a Freedom of Information request states:

“It appears compliance with the minimum setbacks and the noise study approach currently being used to approve the siting of WTGs will result or likely result in adverse effects...” [Ontario Ministry of Environment, memorandum, Ontario Senior Environmental Officer, April 9, 2010]

Krogh (2011) notes:

“To escape the noise some report resorting to sleeping in vehicles, tents, trailers, basements lined with mattresses, garages, and at relatives or friends’ homes. Others have bought or rented a second residence to obtain respite (G.W., Personal communications 2010; T.W., Personal communications, 2011) or relocated with friends or family (T.K., Personal communications, 2011). Some families have been billeted at the IWT developer’s expense (Hansard, 2009, p. G-547). Others have abandoned their homes, or been bought out by wind developers (Braithwaite, Parts I and II, 2009). Buyouts by IWT developers have been reported in other parts of the globe (Rolfe, 2011).”⁵⁹

The Falmouth Board of Health (Massachusetts) USA (note: **bold** face emphasis is that of the Falmouth Board of Health):

“... requests that **Mass DPH immediately initiate a health assessment of the impacts of the operation of wind turbines in Falmouth.** This appeal is compelled by two years of consistent and persistent complaints of health impacts during turbine operation.”⁶⁰

“**Due to the increasing intensity of the reported health impacts, the Board is considering emergency actions.** To determine the appropriateness of such actions,

the Board requests immediate guidance on interim measures to protect the health of affected individuals while the complete health assessment is being conducted.

We look to your Department, as that which holds the highest duty to protect the health of the citizens of the Commonwealth, to assist us in this matter.”⁶¹

It is reported that by order of the court, preliminary injunction shall issue until further order of the court:

“1. The Town of Falmouth, its Selectmen, agents and persons acting in concert shall be restrained from operating the Wind Turbines located at the Waste Water Treatment Facility except during the hours of 7am to 7pm, every day of the week except Sunday. This schedule shall commence on November 22, 2013. Additionally, the same parties shall be restrained from operating said turbines in any fashion on the following limited dates: November 27, 2013; December 25, 2013; and January 1, 2014. ⁶²

The Brown County Board of Health (Wisconsin) USA requests emergency financial relocation assistance:

“...formally requests temporary emergency financial relocation assistance from the State of Wisconsin for those Brown County families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property. The State of Wisconsin emergency financial assistance is requested until the conditions that have caused these undue hardships are studied and resolved, allowing these families to once again return safely to their homes and property.” ⁶³

Subsequent to the above request recent research was conducted at the Shirley Wind Farm, Brown County, Wisconsin, USA. ⁶⁴

"A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin" documents measurement methodologies. The report was prepared cooperatively by:

Prepared Cooperatively By:

Channel Islands Acoustics, Camarillo, CA
Principal: Dr. Bruce Walker

Hessler Associates, Inc., Haymarket, VA
Principals: George F. and David M. Hessler

Rand Acoustics, Brunswick, ME
Principal: Robert Rand

Schomer and Associates, Inc., Champaign, IL
Principal: Dr. Paul Schomer

The primary conclusion of the Shirley Wind Farm study team states: ⁶⁵

The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies.

Some have referenced that World Health Organization Noise Guidelines (2009) recommend

a 40 dB noise level for industrial wind turbines; however, the WHO guidelines are based on road, rail and air craft noise, not on industrial wind turbine noise. Peer reviewed studies consistently acknowledge wind turbine noise is perceived to be more annoying than transportation noise or industrial noise at comparable sound pressure levels.⁶⁶ The premise of 40 dB applying to wind turbines is not supported: research⁶⁷ and Ontario Ministry of Environment field officer⁶⁸ propose 30 to 32 dB.

Regarding low frequency noise, James (2012) states:

“A review of the work of acoustical experts such as Swinbanks, Ebbing, Blazier, Hubbard, and Shepherd and others mentioned in this article shows that these problems were reported at professional conferences and in research papers.

There is sufficient research and history to link the sensitivity of some people to inaudible amplitude-modulated infra and low-frequency noise to the type of symptoms described by those living near industrial wind turbines.

This information should have served as a warning sign.”⁶⁹

Regarding infrasonic sounds, Salt and Huller (2010) state:

“Abstract

Infrasonic sounds are generated internally in the body (by respiration, heartbeat, coughing, etc) and by external sources, such as air conditioning systems, inside vehicles, some industrial processes and, now becoming increasingly prevalent, wind turbines. It is widely assumed that infrasound presented at an amplitude below what is audible has no influence on the ear. In this review, we consider possible ways that low frequency sounds, at levels that may or may not be heard, could influence the function of the ear.

...

There are, however, abnormal states in which the ear becomes hypersensitive to infrasound. In most cases, the inner ear's responses to infrasound can be considered normal, but they could be associated with unfamiliar sensations or subtle changes in physiology. This raises the possibility that exposure to the infrasound component of wind turbine noise could influence the physiology of the ear.”⁷⁰

Regarding low-frequency sounds, Salt and Kaltenbach (2011) state:

“Abstract

Wind turbines generate low-frequency sounds that affect the ear. The ear is superficially similar to a microphone, converting mechanical sound waves into electrical signals, but does this by complex physiologic processes. Serious misconceptions about low-frequency sound and the ear have resulted from a failure to

consider in detail how the ear works. Although the cells that provide hearing are insensitive to infrasound, other sensory cells in the ear are much more sensitive, which can be demonstrated by electrical recordings. Responses to infrasound reach the brain through pathways that do not involve conscious hearing but instead may produce sensations of fullness, pressure or tinnitus, or have no sensation. Activation of subconscious pathways by infrasound could disturb sleep. Based on our current knowledge of how the ear works, it is quite possible that low-frequency sounds at the levels generated by wind turbines could affect those living nearby.”⁷¹

Rand et al (2011) state regarding risk to occupational workers that:

“Abstract

Industrial wind turbines (IWTs) are being installed at a fast pace globally. Researchers, medical practitioners, and media have reported adverse health effects resulting from living in the environs of IWTs. While there have been some anecdotal reports from technicians and other workers who work in the environs of IWTs, little is known about the occupational health sector. The purpose of this case study is to raise awareness about the potential for adverse health effects occurring among workers. The authors propose that there is a need for research regarding occupational worker exposure relating to IWTs.”⁷²

Ambrose et al (2012) investigated low frequency and infrasound and state:

“Abstract

Wind turbines produce sound that is capable of disturbing local residents and is reported to cause annoyance, sleep disturbance, and other health-related impacts. An acoustical study was conducted to investigate the presence of infrasonic and low-frequency noise emissions from wind turbines located in Falmouth, Massachusetts, USA. During the study, the investigating acousticians experienced adverse health effects consistent with those reported by some Falmouth residents. The authors conclude that wind turbine acoustic energy was found to be greater than or uniquely distinguishable from the ambient background levels and capable of exceeding human detection thresholds. The authors emphasize the need for epidemiological and laboratory research by health professionals and acousticians concerned with public health and well-being to develop effective and precautionary setback distances for industrial wind turbines that protect residents from wind turbine sound.”⁷³

Schomer (2013) states:

“This paper is geared towards wind turbine sound, but it is really a simple variation on the basic concepts that this author used in the development of loudness-level-weighted sound exposure (Schomer et al., J. Acoust. Soc. Am, 110(5), Pt. 1, 2390-2397, 2001) and of Rating Noise Curves (RNC) (Schomer, Noise Cont. Eng. J., 48(3), 85-96, 2000), which are used in the Standard, ANSI/ASA S12.2 Criteria for

evaluating room noise. The fundamental issue is: Can we hear slowly surging or pulsating sounds for which the LEQ spectrum is below the threshold of hearing, where "slowly" means that the pulses come at a rate that is no faster than about 4 pulses per second? The short answer is yes, and the longer answer is that this effect is a function of the spectral content and becomes more-and-more prominent as the spectral content goes lower-and-lower in the audible frequency range. So surging or pulsing sound that is primarily in the 16 or 31 Hz octave bands will show the greatest effect. This paper shows the applicability of these results to wind-turbine sound."⁷⁴

There are other references available, some of which have been summarized in the attached *Summary_references_January 2014*.

With respect to very low frequency noise which may not be audible, humans are proposed as "objective measuring instruments (New Experts), whose reports and descriptions must be taken seriously and quantified by technical measurements."⁷⁵

In a conference paper presented to the Acoustical Society of America regarding very low frequency noise measurement, acoustician Bray (2012) states:

At present a growing number of people are reporting sleep deprivation, unease and even illness which they most often ascribe to low frequency sound either near the hearing threshold or, more frequently, sub audible. Such reports are most frequent in rural or quiet suburban areas following the installation of large wind turbines, a new sound source without historic acoustic reference. "⁷⁶

Acousticians Ambrose and Rand (2012) state:

"The best acoustic analyzer for determining human response is the human listening.

This research shows it is not appropriate to use unattended sound measurement instruments."⁷⁷

Krogh et al (2012) reports on human perception to noise:

"... Noise is thus defined as unwanted sound. Sound meters can assess sound; however, humans assess "noise". Sound becomes a risk to human health when it is considered to be noise."⁷⁸

Australian initiatives and a published recommendation by the Society for Wind Vigilance inform a 2 km setback.^{79, 80, 81}

Québec, Canada informs:

"Le gouvernement québécois a officiellement donné son aval à la version modifiée du règlement de contrôle intérimaire (RCI) de la MRC du Haut Saint-Laurent.

Aucune éolienne ne pourra se dresser à moins de 2 km d'une habitation et de 1 km d'une route dans la MRC du Haut-Saint-Laurent, en Montérégie.

Le gouvernement québécois a officiellement donné son aval à la version modifiée du règlement de contrôle intérimaire (RCI) de la MRC du Haut-Saint-Laurent encadrant ces structures sur son territoire, que les maires ont adopté le 9 janvier.”⁸²

Google translate:

“The Quebec government has officially endorsed the amended regulation interim control (ROI) of the Haut Saint-Laurent release.

No wind can not stand less than 2 km from the house and 1 km of a road in the Haut-Saint-Laurent, Montérégie.

The Quebec government has officially endorsed the amended regulation interim control (ROI) of the Haut-Saint-Laurent governing these structures on its territory, the mayors adopted January 9 release.”

4. Conclusion

The Principle Investigator of the Health Canada Wind Turbine Noise and Health study states:

“...there is credible scientific support for an association between wind turbine noise and community annoyance.”⁸³ [Excerpt below]

:

Dr. Michaud acknowledged that there is credible scientific support for an association between wind turbine noise and community annoyance. He explained that the study will help to build the evidence base to determine the link between noise created by wind turbines, including infrasound and low frequency, and variables like sleep disturbance, stress, quality of life and annoyance.

The World Health Organization states with respect to noise in general:

“In all cases, noise should be reduced to the lowest level achievable in a particular situation. Where there is a reasonable possibility that public health will be damaged, action should be taken to protect public health without awaiting full scientific proof.”⁸⁴

The Policy Interpretation Network on Children’s Health and Environment advises:

“Policies that may protect children’s health or may minimise irreversible health

effects should be implemented, and policies or measures should be applied based on the precautionary principle, in accordance with the Declaration of the WHO Fourth Ministerial Conference on Environment and Health in Budapest in 2004.”⁸⁵

I trust the information provided will be helpful and given consideration by the AMA, If I can be of assistance, please do not hesitate to contact me.

Yours truly,

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Attachments

Adverse health effects and industrial wind energy facilities March 18, 2014
Summary_references_February 2014
Jeffery et al (May and Sept 2013; Jan 2014)
Health Canada Risks to children December 27 2012 FINAL

Krogh peer reviewed publications

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Terry Sprague, M. Elizabeth Harrington, and Carmen M. E. Krogh, DOI:
10.1177/0270467611417844 <http://bst.sagepub.com/content/31/5/377>

Conference papers

Wind Turbine Facilities' Perception: A Case Study from Canada
Peter N. Cole MD, MHSc, FRCP(C) and Carmen Krogh, BScPharm
5th International Conference on Wind Turbine Noise Denver 28 – 30 August 2013 (published in proceedings but not presented)

Audit report: literature reviews on wind turbine noise and health
Brett Horner, Carmen ME Krogh, Roy D Jeffery Paper presented at the Wind Turbine Noise conference 2013, August 28 to 30, Denver, Colorado, USA

Trading off human health: Wind turbine noise and government policy
Carmen ME Krogh, Joan Morris, Murray May, George Papadopoulos, Brett Horner
Paper presented at the Wind Turbine Noise conference 2013, August 28 to 30, Denver, Colorado, USA

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