

# Power Lines and Health: The Evidence and Public Policy

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National Collaborating Centre  
for Environmental Health  
Centre de collaboration nationale  
en santé environnementale



BC Centre for Disease Control  
An agency of the Provincial Health Services Authority



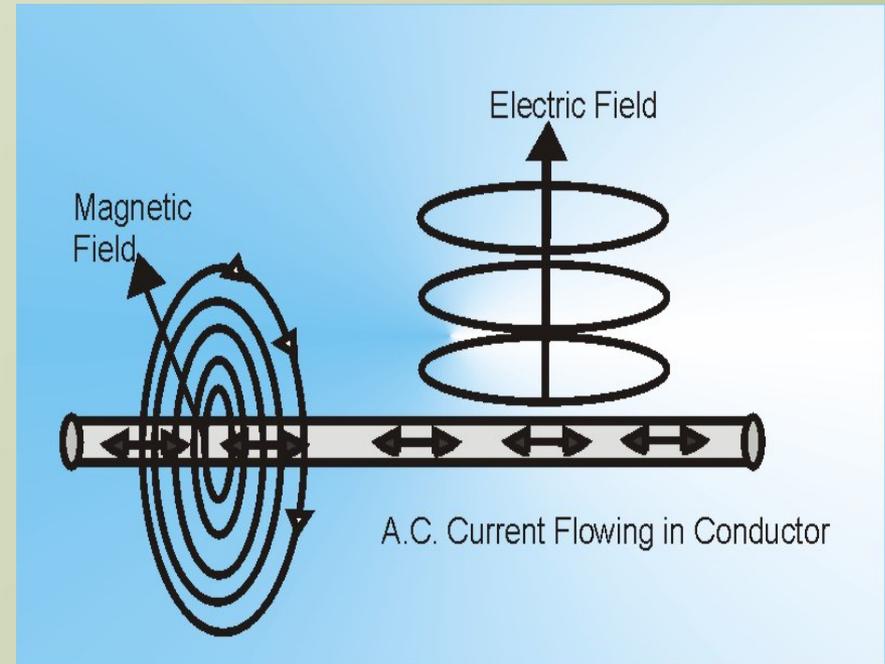
Alberta Health  
Services

# Outline

- **Background on power lines and EMF**
- **The evidence for health effects**
- **Power lines and public policy**
- **Case example of how to deal with public concerns**

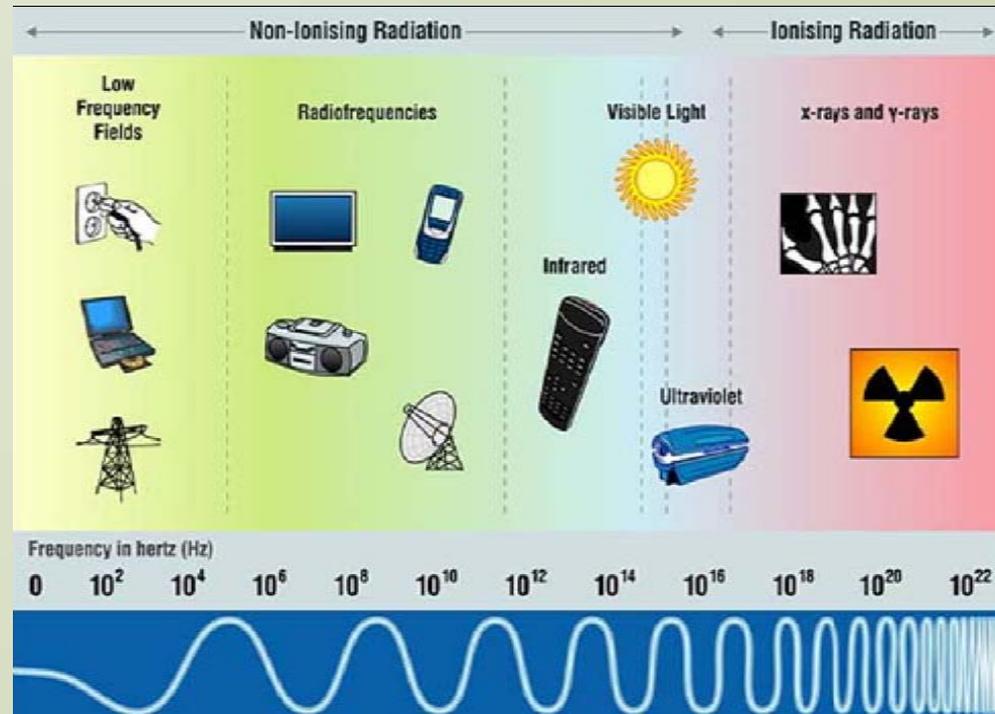
# Background on Power Lines

- **Power lines emit electromagnetic fields (EMF)**
  - **Magnetic fields**
  - **Electric fields**
  
- **Exposure to EMF**
  - **Multiple**
  - **Ubiquitous**



# EMF

- One type of non-ionizing, extremely low frequency (ELF) radiation



# **Evidence for Health Effects**

## Health Outcome

## The Scientific Evidence\*

Adulthood cancers

Inconsistent

Cardiovascular

Inconsistent

Reproductive & developmental

Inconsistent

Neuroendocrine disorders

Inconsistent

Neurodegenerative disorders

?

Found mainly among individuals with occupational exposures

**Childhood Leukemia**

**Most consistent**

*\* Based on WHO Monograph No. 238 on ELF EMF (2007)*

# International Agency for Research on Cancer (2002)

- **ELF EMF possibly carcinogenic to humans (Group 2B)**
- **Limited evidence**
  - in humans for the carcinogenicity of ELF magnetic fields in relation to childhood leukemia
- **Inadequate evidence**
  - in humans for carcinogenicity of ELF magnetic fields in relation to all other cancers

# EMF & Childhood Leukemia

- **A study by Wertheimer & Leeper (1979) was the first to suggest an association**
- **Since then, many studies have investigated this relationship**

# Methods of Exposure Assessment

- **Magnetic field measurements within/around homes**
- **Distance between home and power lines**
- **Other proxy: wire codes classification, calculated field strengths (from historical data)**



## Pooled Analyses of Studies Investigating EMF Exposure & Childhood Leukemia

Study	Exposure Metric	Cases/ Controls	Exposure	Odds Ratio (95% CI)
Ahlbom et al. (2000) - 9 studies	24/48 hr calculated magnetic field	233 / 332	0.1 to <0.2 $\mu$ T	1.08 (0.89- 1.31)
		104 / 147	0.2 to <0.4 $\mu$ T	1.11 (0.84- 1.47)
		44 / 62	$\geq$ 0.4 $\mu$ T	2.00 (1.27- 3.13)
Greenland et al. (2000) - 15 studies	Direct measures / calculated magnetic field / wire codes	302 / 410	0.1 to <0.2 $\mu$ T	1.01 (0.84- 1.21)
		89 / 126	0.2 to <0.3 $\mu$ T	1.06 (0.78- 1.44)
		99 / 121	$\geq$ 0.3 $\mu$ T	1.7 (1.2-2.3)

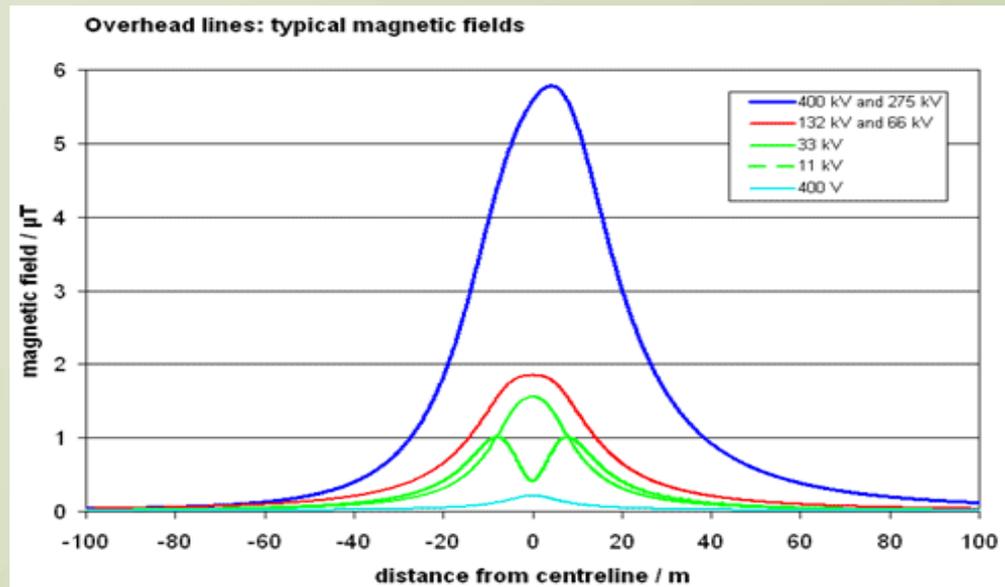
# The Relationship Between Distance & Childhood Leukemia

Distance to line (metres)	Relative Risk (95% CI)
0-49	1.67 (0.40 - 6.97)
50-69	1.51 (0.48 - 4.79)
70-99	2.02 (0.76 - 5.39)
100-199	1.64 (1.00 - 2.71)
0-199	1.69 (1.13 - 2.53)
200-599	1.23 (1.02-1.49)
≥600 (reference group)	1.00

*Draper et al. (2005)*

# Some Problems with Interpretation

- **What is the appropriate exposure measure?**
  - Traditionally thought to be field strength but is there something we are missing?



# Some Problems with Interpretation (2)

- **Field strength alone may not provide all the information**
  - **Spot measurements may not take into account variability in exposures**
  - **Field strength will change with electrical load**
- **No known biological mechanism**
  - **Makes it difficult to know what to measure**



# Some Problems with Interpretation (3)

- **Time period of exposure may differ between studies**
  - Longest lived residence, time of study, at birth
- **EMF exposures are ubiquitous and many**
  - Difficult to assess exposure to a particular source
- **Confounders may exist, although none have been adequately substantiated**
  - Socioeconomic status, traffic density, residential mobility, population mixing

# If the Relationship Between Distance & Childhood Leukemia is Real...

- **There is some evidence to suggest a weak association between childhood leukemia & EMF exposure**
- **On a statistical basis\*, this equates to:**
  - **4 additional leukemia cases/year in Canada**
  - **(range between 1-9 cases/year)**

*\* based on assumptions used by Draper et al. (2005)*

# Possible Solutions?

- **Maintain a distance of >600 metres between susceptible population & major transmission lines**
  - **Extremely difficult to implement**
  - **Requires major shift in land use**
- **Bury power lines**
  - **Addresses property values & aesthetic concerns**
  - **But is it protective of health?**
  - **May not be economically feasible in many cases**



# **Power Lines and Public Policy**

# Policy Approaches

- **Precautionary principle**
  - **Taking action on a potentially serious risk in face of scientific uncertainty**
- **Prudent policy**
  - **Implementing risk reduction measures that are cost-efficient**  
**Eg. re-routing power lines away from homes, schools, hospitals**

# Health Canada

- **No exposure guidelines for the general public**
- **No action required at an individual level**
  - **“You do not need to take action regarding typical daily exposures to electric and magnetic fields at extremely low frequencies”**
  - **“For the most part, typical EMF exposures in Canadian homes, offices and other work sites, are *far below...* guidelines [issued by other organizations].”**

(<http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/magnet-eng.php>, Nov 2009)

# Toronto Public Health

- **Recommend that individuals reduce exposure**
  - **“increasing the distance between you and a source of EMFs (power lines or electrical appliances) will easily reduce your level of exposure to EMFs”**
  - **reduce exposures in homes, office, community**
  - **“prudent avoidance for exposures to EMFs in and next to hydro corridors”, “encourage developers... to reduce potential exposures”**

(<http://www.toronto.ca/health/emfs.htm>, Nov 2009)

# Other Jurisdictions

- **California Dept of Education requires setback distances for new schools from overhead & underground transmission lines**
- **EU has adopted ICNIRP\* exposure guidelines for the general public, while some European countries have taken additional precautions including:**
  - **Adopting limits or standards based on these guidelines**  
**In Switzerland, new constructions which emit EMF at places of “sensitive use” (hospitals, schools, homes) must comply with additional installation limit values**
  - **Adopting setbacks from homes, schools, hospitals**  
**Spain, Norway, Sweden prohibit construction of new power lines within 300 feet of homes**

*\* International Commission on Non-Ionizing Radiation Protection*

# Summary

- **EMF exposures are ubiquitous and sources are many**
- **There is no known biological mechanism for health effects**
- **Field strength measurements may not provide all the information relating to exposure**
- **Epidemiological studies suggest a weak association between EMF exposure and childhood cancer**
- **Public policy on EMF exposure from power lines differs among jurisdictions**

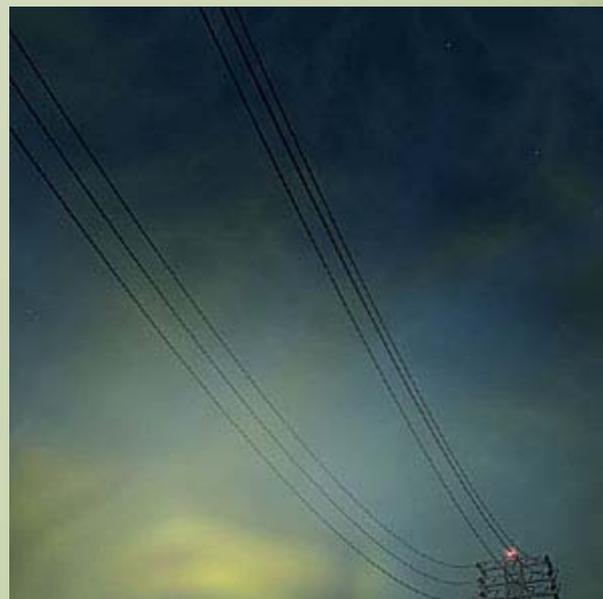
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# **How To Deal With Public Concerns**

# Case Example

- School board held a public meeting with parents to discuss locating a school within 110 meters from a set of power lines

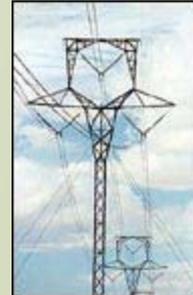
**108 meters away, magnetic field readings of 2 mG**



**Parent Lobby  
Derails School,  
Oct 26**



**School construction  
halted over health  
fears - Oct 27**



**Let experts give  
high-voltage  
advice - Oct 31,  
Editorials**



**School-Power  
Line Controversy  
Dubious science,  
cancer fear win  
out - Oct 29**



**Voodoo science  
threatens safety  
of children -  
Letters, Oct 31**

- **Electrical Engineer from Calgary utility**
- **Possible carcinogen (limited data from human, insufficient data from animal)**
- **No health risk**
- **Technical studies**

- **Exposure levels from power line 2 mG compared to 100-200 mG from appliances, therefore not a concern**



**Will you let your family live by power line?**





**Set up**



# Strategy

## Health Professional

- Same organization that inspects restaurants, gives immunizations to protect their children
- To provide information and not to speak for or against locating school close to power lines

# Terms

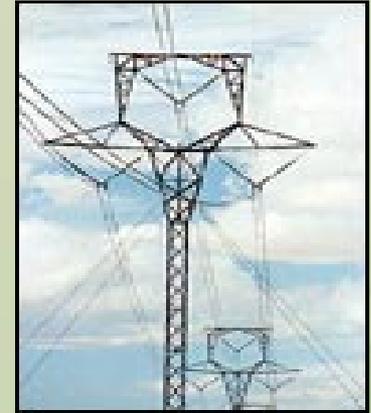
- **Magnetic fields classified as Possible carcinogen !**
  - **Same category as coffee (urinary bladder cancer), pickled vegetables, dry cleaning**
  - **Solar radiation is a known carcinogen**
- **Unknown and uncertainties**

## Fear Factor



# Scenarios

- **Staying at school for 8 hours at 2 mG would expose individuals to 960 mG**
- **Using hair dryer for 15 minutes at 70 mG would give 1,050 mG exposure**





Health  
Canada

Santé  
Canada



## Per capita energy consumption:

- 1961- 2.66 Megawatt-hour
- 1971- 6.39 Mw-hr
- 1981- 10.59 Mw-hr
- 1991- 16.25 Mw-hr

## Leukemia rate for 5-9 Mw-hr:

1984- 4.35 /100,000

1998- 2.77/100,000

# Control

- **Gave the public information on how to reduce EMF exposure in their home:**
  - **Electrical blanket**
  - **Digital clock by night table**
  - **Cell-phone base station by night table**
  - **Baby monitor in crib**



**Will I let my family live near a power line?**

# Summary

- **Let the public express their view**
- **Gain their trust**
- **Show that you care and listen to their concerns**
- **Communicate using terms they understand and daily scenarios they can relate to**
- **Give them control**



# *HOW?*

- **Don't be too technical**
  - (what is  $10^{-4}$ ?)
- **Don't use math**
- **Don't talk down**
- **Use examples public can understand**

# ***HOW?***

- **Don't tell the public not to worry, tell them what to do**
- **Explain risk-reducing steps (risk management)**
- **Share power and responsibility – accept and involve the public**
- **The public has to learn to live with uncertainty**

# Thank You!

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BC Centre for Disease Control  
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