Review of health effects and gaps in knowledge

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Issues to be discussed

- What are the known health effects of ELF and RF
- Gaps in knowledge
- How do we assess risks
- Uncertainty in the science and public concern
Health effects of ELF field exposure are due to induced electric currents and fields.

Health effects: Nerve and muscle stimulation effects depend on the current density (> 10 mA/m²)

Effects not established: Cancer, memory loss, suicide, neurodegenerative such as Alzheimer's and Parkinson's disease, and subjective effects
ELF exposure

Known to induce electric fields and currents in the body

- ICNIRP limits restrict induced currents from external fields to no more than endogenous currents
- No adverse health effect established below these limits

Gaps in knowledge?

- ELF magnetic fields classified as a “possible human carcinogen” by IARC: studies suggest association between exposure to these fields and childhood leukaemia
- Are epi study results due to selection bias, contact currents, transients, other mechanisms etc?
- No real support from animal or other studies
Transient magnetic flux density with distance from dimmer switch

(Ref: EPRI TR-103470, Residential transient magnetic field research, March 1994)
"Possibly carcinogenic to humans": IARC classification to denote agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals.

This classification is the weakest of three categories ("is carcinogenic to humans", "probably carcinogenic to humans" and "possibly carcinogenic to humans") used by IARC to classify potential carcinogens based on published scientific evidence.
### Examples of agents classified by IARC

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples of Agents</th>
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<tbody>
<tr>
<td><strong>Carcinogenic to humans</strong></td>
<td>Asbestos</td>
</tr>
<tr>
<td>(usually based on strong evidence of</td>
<td>Mustard gas</td>
</tr>
<tr>
<td>carcinogenicity in humans)</td>
<td>Tobacco (smoked and smokeless)</td>
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<td></td>
<td>Gamma radiation</td>
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<tr>
<td><strong>Probably carcinogenic to humans</strong></td>
<td>Diesel engine exhaust</td>
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<tr>
<td>(usually based on strong evidence of</td>
<td>Sun lamps</td>
</tr>
<tr>
<td>carcinogenicity in animals)</td>
<td>UV radiation</td>
</tr>
<tr>
<td></td>
<td>Formaldehyde</td>
</tr>
<tr>
<td><strong>Possibly carcinogenic to humans</strong></td>
<td>Coffee</td>
</tr>
<tr>
<td>(usually based on evidence in humans which</td>
<td>Styrene</td>
</tr>
<tr>
<td>is considered credible, but for which other</td>
<td>Gasoline engine exhaust</td>
</tr>
<tr>
<td>explanations could not be ruled out)</td>
<td>Welding fumes</td>
</tr>
<tr>
<td></td>
<td>ELF magnetic fields</td>
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What should national authorities do about “Possible human carcinogens”

- Other explanations possible for the observed association e.g. selection bias, exposure to other field types (transients, high frequency harmonics)

- EMF Project helps national authorities balance benefits of electrical technology against possible health risks...help them decide what protective measures needed. Difficult to suggest protective measures because dont know what ELF field characteristic involved or if ELF magnetic fields responsible

- Need focused research program to elucidate possibilities

- Suggest voluntary policies that aim to cost-effectively reduce exposure to ELF fields. See WHO Backgrounder (March 2000)

(see: http://www.who.int/peh-emf/publications/facts_press/EMF-Precaution.htm)
RF health effects are due to heating from exposure above 4 W/kg

- Behavioural changes
- Reduced endurance
- Field avoidance

Effects not established:
- Memory loss
- Cancer
- Blood pressure changes
- Subjective effects
- Blood brain barrier
Health effects of RF fields

- Known to cause heating that can affect animal behaviour, endurance etc…basis of ICNIRP and other standards
- No other RF interaction mechanism established that could have health implications
- “..balance of evidence to date suggests that exposure to RF radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population” IEGMP 2000
- However there are effects reported on brain function etc, and hypothesise effects from pulsed signals that may or may not cause any health consequence that need further research…. IEGMP 2000
Health hazard of mobile phones:
Driving while using a mobile phone is dangerous
Some studies suggest effects below standards eg altered reaction times, effects on behaviour and sleep, hypersensitivity. Some recent technologies lack studies eg mobile phones. IEGMP recommended research as follows:
- Effects on brain function
- Consequences of exposure to pulsed signals
- Improvements in dosimetry
- Impacts of sub-cellular and cellular changes
- Psychological and sociological studies...
- Epi and human volunteer studies, including study of children and individuals who might be more susceptible to RF...
Electromagnetic Hypersensitivity (EHS)

- EHS has no clear diagnostic criteria
- There is no scientific basis to link EHS symptoms to EMF
- Similar range of non-specific symptoms as:
  - Multiple chemical sensitivities (MCS): attributed to low-level exposures to chemicals in the environment
  - Environmental somatization syndrome (ESS): attributed to environmental factors; sufferer rejects alternative explanations
Biological and Health Effects

- WHO defines health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity.
- Biological effects are measurable responses to EMF exposure. ....not necessarily hazardous.
- Health hazard is a biological effect producing consequences outside the body's normal range of physiological compensation and is detrimental to health or well-being.
- **Problem:** the public and media do not discern between biological and health effects.
Psychosocial effects or hypersensitivity to EMF

- WHO’s definition of health requires that effects such as headaches, sleep disturbance, irritability or other effects that compromise well-being must be taken into account
- Effects must be valid reproducible responses to EMF exposure
Electromagnetic Hypersensitivity (EHS)

EHS Symptoms

? Nervous system symptoms (e.g. sleep disturbances, fatigue, stress)

? Skin symptoms (e.g. facial prickling, burning sensations, rashes)

? Various body symptoms (e.g. pain and ache in muscles)

? Eye symptoms (e.g. burning sensations)

? Various less common symptoms that include ear, nose, and throat problems, as well as digestive disorders

? Symptoms faced by EHS individuals are certainly real
Electromagnetic Hypersensitivity (EHS)
Assisting EHS individuals

- Medical evaluation to identify and treat conditions responsible for symptoms
- Hygienist evaluate workplace or home for factors that might contribute to the symptoms
- Physicians communicate and help develop strategies for coping
- Provide EHS individuals, health-care professionals and employers with targeted and balanced information about EMF and a statement that no scientific basis exists for a connection between EHS and exposure to EMF
**EMF fields**

**What is the way forward?**

- Need a thorough review of all scientific studies
- Properly coordinated and focused research program to fill gaps required for better health risk assessments
- Clear research agenda for scientists to complete
- When “sufficient” research completed need recognised health risk assessment program to evaluate results and risks to health
- Health risk assessment program should be oriented to advise national authorities on protecting their populations
- Process and information must be disseminated in a user-friendly way to the public, workers, government and industry
Hill Criteria to Assess Health Risk

✔ Strong association between exposure and risk?
✔ Consistent association between exposure and health outcome?
✔ Dose-response relationship?
✔ Good laboratory evidence to support epi results?
✔ Plausible biological mechanism(s)?

Not all criteria need to be met… and seldom are…

but data as a whole need to be convincing!

Overall assessment: Weight of evidence

- All evidence considered as a whole: No one study is definitive
- Scientific judgement: reflecting strength of evidence from studies in humans, animals and other relevant data
- No way to prove something does not cause effects; need to determine how much a set of evidence changes probability that exposure causes an outcome
- Health risk assessments by WHO Task Group
Uncertainty in the science and public concern
Public concern about possible health hazards

Some epidemiological studies suggest a weak association between exposure to EMF and a variety of health problems (e.g. ELF magnetic fields classified by IARC as “possible human carcinogen”… how will they classify RF fields?)

Some unreplicated reports of biological effects at EMF levels below international guidelines have been published

Some technologies (e.g. mobile phones) are relatively new, and few health studies have been performed using EMF characteristics they emit

Established exposure guideline limits may not protect certain sub-populations who may be more sensitive to EMF (e.g. children, hypersensitives)

Large national variations in EMF exposure limits, and therefore different levels of protection… creates great uncertainty in the public mind
Role of the *Precautionary Principle* in EMF to be discussed by Dr. Kheifets
Further information

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