WHO EMF RESEARCH PRIORITIES - UPDATE

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WHO EMF Research Priorities

Structure:

• WHO Research Agenda; objectives and derivation
• Key meetings, workshops and the EHCs
• ELF Research Agenda; 'Weak Electric Fields' Workshop
• IF Research Agenda
• RF Research Agenda; 'Adverse Temperatures' Workshop
• Summary
WHO Research Agenda

Promote studies which demonstrate reproducible effects of EMF exposure that are likely to occur in humans and that have potential health consequences.

Essentially:

• Refine the uncertainties in the evidence underpinning present EMF guidance

• Evaluate health risks to the population from low level exposures, for example from power lines and new technologies such as mobile phones
WHO EMF Research Priorities

Identified in the EMF Research Agenda as a set of EMF research recommendations for the international community, usually the output of:

- Environmental Health Criteria Reports
- WHO/ICNIRP Workshops, Symposia, etc
- Ad Hoc Expert Committees (occasionally)
Existing WHO EMF EHCs

- EHC 35 Extremely low frequency (ELF) fields (1984)
- EHC 69 Magnetic fields (1987)
- EHC 137 Electromagnetic fields (300 Hz-300 GHz) (1993)
Key ICNIRP/WHO International Seminars 1996 - 2001:

• Non-Thermal Effects of RF (10 MHz – 300 GHz) - Munich, 1996*
• Static and ELF EMFs (0 – 300 Hz) - Bologna, 1997*
• Intermediate Frequencies (300 Hz – 10 MHz) - Maastricht, 1999*
• Pulsed RF Fields (10 MHz – 300 GHz) - Erice, 2001*

*Incorporated into the current WHO Research Agenda
Key ICNIRP/WHO Workshops 2002 - 2004:

- Adverse Temperature Levels Workshop - Geneva, 2002*
- Weak ELF Electric Fields Workshop - NRPB, 2003
- *Ad hoc RF Research Agenda Committee - Geneva 2003*
- Static Magnetic Fields Workshop - NRPB, 2004
- Childhood sensitivity - Istanbul 2004
- Hypersensitivity - Prague, 2004

*Incorporated into the current WHO EMF Research Agenda
ELF ELECTROMAGNETIC FIELDS

Known effects:

Nerve/muscle stimulation at high fields; induction of phosphenes and probable effects on cognition and other CNS functions

Uncertainties:

Whether association between high residential magnetic fields and childhood leukaemia causal; possible effects on melatonin, breast cancer, neuro-degenerative disease, hypersensitivity etc.
Research Agenda – ELF Magnetic fields

Bologna, 1997

• Overarching need to consider role of EMF transients
• At least two large scale (NTP) animal cancer studies ✔
• At least two large scale epi' studies of childhood leukaemia ✔
• Large scale epi' studies for breast cancer and neurodegeneration
• Volunteer studies of EMF effects on plasma melatonin levels ✔?
• Evaluate need for further study of hypersensitivity - ongoing
• Replication of positive in vitro and in vivo studies concerning signal transduction, gene expression, proliferation etc ✔
ELF Research Agenda – Future directions?

• Cancer endpoints - AGNIR (UK), 2001
  1. Extend Nordic studies of childhood leukaemia
  2. Refine cohort studies of heavily exposed workers
  3. Further animal studies using appropriate transgenic leukaemia and brain cancer models.

• Refine basis for ELF exposure standards – NRPB, March 2003
• Childhood sensitivity – Istanbul, June 2004
• Hypersensitivity – Prague, October 2004
• ELF EHC – 2005
Weak Electric Field Effects: NRPB, 2003

Focus was on the susceptibility of the CNS and other tissues to 'weak' ELF electric fields, especially:

• Voltage-gated ion channels and neuronal networks

• Experimental evidence for effects in brain neural circuitry, and on visual and cognitive function

• Possible sensitive sub-groups

• The susceptibility of other tissues, incl' the embryo/fetus.
Weak Electric Field Effects: NRPB 2003

Broad outcomes:

- **Physiologically** weak electric fields are likely to affect CNS function.
- The neural circuitry of the retina provides a good model system.
- Cognitive studies have not been particularly informative.
- People with epilepsy are likely to form a susceptible sub-group.
- Other tissues, including the heart, pineal organ and developing embryo, are less susceptible.
Weak Electric Field Effects: NRPB, 2003

Research proposals:

- Further experimental and dosimetric investigation of the retinal 'phosphene' response.
- Further study of the sensitivity of the hippocampus and other brain areas to electric fields.
- More definitive cognitive studies need to be carried out using standardised methodologies.
INTERMEDIATE (300 Hz - 10 MHz) EMFs
INTERMEDIATE (300 Hz - 10 MHz) EMFs

Known Effects

• Induced electric field effects give way to RF heating

Uncertainties

• Paucity of data, excepting for VDUs

WHO Research Agenda (Maastricht, 1999)

• Refine threshold values for known effects
• Evaluate feasibility of epidemiological studies
RADIOFREQUENCY EMFs

WHO International EMF Project
9th International Advisory Committee, Istanbul, June 2004
RADIOFREQUENCY EMFs

Known effects:

RF-induced heating: thermoregulatory, neurobehavioural and developmental effects at body temperature increases > 1°C.

Uncertainties:

Current experimental and epidemiological database insufficient to determine health risk, if any, posed by low level RF, particularly that used by mobile phones. Major issues concern cancer, cognition and children.
**Adverse Temperature Levels: Geneva, 2002**

Focus was on raised temperatures and heat stress in humans in relation to:

- Healthy and vulnerable populations, especially heat-related mortality in the elderly
- The workplace, particularly in relation to cognitive function and accident rates
- Prenatal development
Adverse Temperature Levels: Geneva, 2002

Broad outcomes:

• During high environmental temperatures, the elderly are susceptible to small increases in heat load

• Accident rates increase and cognitive function decreases with increased heat load, but not well-quantified

• There are uncertainties in the experimental data concerning heat and prenatal development
Adverse Temperature Levels: Geneva, 2002

Research proposals:

• Further study of the effects of RF-induced heating on cognitive performance in volunteers and animals

• Development of computer models of RF deposition and temperature regulation, including pregnancy

• Further study of raised maternal temperatures on CNS development
RF Research Agenda: Geneva, 2003

Broad research areas:

• Overarching issues: - rigorous study design, better dosimetry, etc
• Epidemiology
  ongoing       urgent       future
• Human laboratory studies
  "             "             "
• Animal laboratory studies
  "             "             "
• Tissues, cells, cell-free systems, lab studies
  "             "             "
RF Research Agenda: Geneva, 2003

Epidemiological studies

• **Ongoing:** International case-control brain tumour study

• **Urgent:** Improved individual exposure assessment

• **Future:** International cohort study of mobile phone users
  Studies on sleep and other 'soft' outcomes
RF Research Agenda: Geneva, 2003

Human laboratory studies

• **Ongoing**: Studies on reaction time and memory

• **Urgent**: Include children in cognitive studies; further investigation of sleep and headache effects.

• **Future**: The effects of RF-induced heating on cognitive performance
RF Research Agenda: Geneva, 2003

Animal laboratory studies

• **Ongoing**: Rodent NTP bioassays; behavioural studies, balance and auditory function, etc

• **Urgent**: Immune system, BBB and neuropathology, sleep; effects of RF-induced heat on corticogenesis.

• **Future**: Consider evaluating: effects of novel RF pulse sequences
RF Research Agenda: Geneva, 2003

Tissues, cells, cell-free systems laboratory studies

- **Ongoing:** Hippocampal slice electrophysiology; genotoxicity
- **Urgent:** Stress (eg heat shock) protein expression; evaluation of new proposed interaction mechanisms
- **Future:** Modern high-throughput molecular assays such as proteomics and genomics, for rapid screening
RF Research Agenda – Future directions?

• Childhood sensitivity – WHO Workshop, Istanbul, June 2004
• Hypersensitivity – WHO Workshop, Prague, October 2004
• IARC RF Review – Lyon, 2005?
• ICNIRP Review – 2005?
• RF EHC – 2006
WHO EMF RESEARCH PRIORITIES

Summary: Present Status and Future Directions

• Current Static and ELF research agendas – Bologna 1997 workshop

• Current IF research agenda - Maastricht 1999 workshop

• Current RF research agenda - Ad Hoc Expert Committee (Geneva, 2003)

• Recent and future workshop proceedings incorporated in the recommendations of the Static (2004), ELF (2005) and RF (2006) EHC Reports