



# The EFHRAN project: an European experience of EMF Health Risk Assessment

**Paolo Ravazzani**



Consiglio Nazionale delle Ricerche  
Istituto di Ingegneria Biomedica ISIB

# The EFHRAN Project

- European Commission
- Executive Agency for Health and Consumers EAHC
- Health 2008 Programme - Second programme of community action in the field of health (2008-2013)
  - Starting date: February 1, 2009
  - Ending date: July 31, 2012
  
- Consiglio Nazionale delle Ricerche, Istituto di Ingegneria Biomedica – Italy - *Paolo Ravazzani*
- ICEMB – Italy - *Guillermo D’Inzeo*
- Fundació Centre de Recerca en Epidemiologia Ambiental (CREAL) – Spain - *Elisabeth Cardis*
- Institute of Nonionizing Radiation – Slovenia - *Peter Gajšek*
- Kraeftens Bekaempelse (Danish Cancer Society) – Denmark - *Aslak Harbo Poulsen & Joachim Schüz*
- Health Protection Agency – United Kingdom - *Zenon Sienkiewicz*
- National "Frédéric Joliot-Curie" Research Inst. for Radiobiology and Radiohygiene – Hungary - *Gyorgy Thuroczy*
- Laboratoire de l'Intégration du Matériau au Système, UMR 5218 CNRS – France - *Bernard Veyret*



# Activities

## **Risk Analysis**

- Report on the analysis of risks associated to exposure to EMF: in vitro and in vivo (animals) studies [July 2010]
- Risk analysis of human exposure to EMF [July 2010 – revised October 2012]

## **Exposure Assessment**

- Report on the level of exposure (frequency, patterns and modulation) in the European Union. Part 1: Radiofrequency radiation [August 2010]
- Report on the level of exposure (frequency, patterns and modulation) in the European Union. Part 1: Low frequency fields [June 2011]

## **Dose-response assessment and risk characterization**

- Reports on health impact [October 2012]

## **Input to the future**

- Report on inputs to future risk management processes [October 2012]



## in vitro \_ in vivo animals: ELF magnetic fields

Outcome	Strength of evidence
<b>Cancer studies</b>	
- <i>In vivo</i>	Lack of effect
- <i>In vitro</i>	Inadequate evidence
<b>Other health effects</b>	
<i>In vivo</i>	
- Behaviour	Limited evidence
- Memory	Limited evidence
- Haematology	Inadequate evidence
<i>In vitro</i>	
- Calcium ion	Limited evidence
- ROS	Limited evidence
- Genotoxicity	Limited evidence

## in vitro \_ in vivo animals: Intermediate frequencies

Outcome	Strength of evidence
<b>Development</b>	Lack of effect
<b>Genotoxicity</b>	Lack of effect

Sufficient evidence
Limited evidence
Inadequate Evidence
Lack of effects

## in vitro \_ in vivo animals: RF radiofrequencies

Outcome	Strength of evidence
<b>Cancer studies</b>	
- Genotoxic effects	
<i>In vitro</i>	Limited evidence
<i>In vivo</i>	Lack of effect
- Non genotoxic effects	
<i>In vitro</i>	Inadequate evidence
<i>In vivo</i>	Inadequate evidence
<b>Nervous system</b>	
- BBB	Lack of effect
- Stress response	Limited evidence
- Gene expression	Inadequate evidence
- Neurodegenerative disease	Inadequate evidence
- Neurogenesis	Inadequate evidence
- Behaviour	Inadequate evidence
- <i>In vitro</i>	Limited evidence
<b>Development and reproduction</b>	
- Development, teratology	Inadequate evidence
- Reproduction	Inadequate evidence
- <i>In vitro</i>	Inadequate evidence
<b>Miscellaneous</b>	
- Auditory	Lack of effect
- Immunology	
<i>In vivo</i>	Inadequate evidence
<i>In vitro</i>	Inadequate evidence

Sufficient evidence
Limited evidence
Inadequate Evidence
Lack of effects

# Humans

Adverse health outcome		Low frequency	IF	High frequency
Cancer	Leukaemia in children	Orange	Yellow	Yellow
	Brain tumour in children	Yellow	Yellow	Yellow
	Brain tumour in adults	Yellow	Yellow	Orange
	Breast cancer in adults	Green	Yellow	Yellow
	All other cancers	Yellow	Yellow	Yellow
Neurodegenerative diseases	Alzheimer's	Yellow	Yellow	Yellow
	ALS	Yellow	Yellow	Yellow
	Other diseases	Yellow	Yellow	Yellow
Reproductive outcomes	All	Yellow	Yellow	Yellow
Cardiovascular diseases	All	Green	Yellow	Yellow
Well-being	EHS	Green	Yellow	Green
	Symptoms	Yellow	Yellow	Yellow

Sufficient evidence
Limited evidence
Inadequate Evidence
Lack of effects

## Summary of RF Exposure Assessment

1. The general RF exposure level of the population from the fixed RF sources including LF/MF broadcast, VHF broadcast, UHF TV and telecommunications is very low. **The range is between 0,01-1 V/m in Europe** that is many times below the exposure limits of EU recommendations.
2. The results of exposure measurements show that **more than 60% of recorded total EMF exposures were below 1 V/m**, less than 1% above 6 V/m and only less than 0,1 % were above 20 V/m field strength. The relevant European recommended exposure limit for the public is **in the range of 28 V/m to 87 V/m**.
3. The contribution of the RF exposure from wireless telecommunication technology is continuously increasing and now **is above 60 % of the total exposure**.

## Summary of ELF Exposure Assessment

- The general ELF exposure level of the population is very low, between 0.01 and 0.1  $\mu\text{T}$ . Approximately 0.5 % of general population are exposed continuously to levels above 0.2  $\mu\text{T}$  from the fixed outdoor ELF sources (i.e. high-voltage power lines, lines of transport systems).
- Relatively elevated ELF exposure (up to a few  $\mu\text{T}$ ) can be seen in apartments above built-in line transformers.
- Looking at geographical distributions, no noticeable differences are seen among the different EU countries.
- The major part of the ELF public exposure comes from electric household devices, but in this case the duration of exposure is very limited.
- For cumulative exposure, approximately one third of the total exposure can be attributed to personal appliance use.
- Low availability of data about actual levels of exposure of the population



## Health impact

### ELF Exposure – Residential exposure

- **Assuming that the association is causal**, the possible childhood leukaemia cases attributable to ELF exposure corresponds to between 1.0% and 2.0% of all childhood leukaemia cases in the EU27. Hence, the possible contribution to cases of leukaemia is relatively low and characterized with considerable uncertainty.
- Considerable uncertainties are due to scarce data on exposure and the choice of exposure-response model, demonstrating the importance of understanding mechanisms of the association between ELF MF exposure and childhood leukaemia.
- Improved monitoring of residential exposures to ELF MF in Europe cannot be delayed anymore.

### RF Exposure – Mobile phones

- Health impact cannot be interpreted beyond the weight of the epidemiological study from which the exposure-response data were derived, i.e., any public health implications **are conditional on assuming that the association demonstrated in that study is causal**.
- The considerable uncertainties are such that at present, effective public health would benefit from much better availability of data relating to population exposures (i.e. mobile phone usage data).



## Inputs to future risk management and communication actions 1/2

- Investment in the collection of data on the actual levels of EMF exposure among the European population, for all frequency ranges.
- Investment in the study of biophysical and biological mechanisms of interaction, using innovative theory and techniques, such as quantum mechanics (QM) molecular simulations, systems biology and proteomics.
- Investment in studies related to specific novel uses of EMF-emitting devices, in particular at Intermediate Frequency technologies (radio frequency identification systems (RFID), anti-theft gates), and specific population subgroups, such as children.
- Building upon existing epidemiological resources with improved exposure assessment and exposure validations to provide answers to outstanding questions on EMF health effects (reproductive, behavioral, cancer, etc.) in relation to RF and IF wherever possible.

## Inputs to future risk management and communication actions 2/2

- Evaluating, where possible, joint effects of EMF and of other environmental agents to which humans are exposed in the general environment and at work.
- Investment in (technical and non-technical) methods for reducing exposure of the population, and to improve and facilitate health risk communication to the general public.
- Improvement in health risk communication to reduce the gaps between relevant scientific evidence and European citizens' health risk perception.

*Science consists in grouping facts so that general laws or conclusions may be drawn from them*

*Charles Darwin*



<http://efhran.polimi.it>

