

The International EMF Project

Update on the Radiofrequency Fields Environmental Health Criteria

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World Health
Organization

World Health Organization

- **Function:** act as the UN directing and coordinating authority on international health work
- **Objective:** attainment by all peoples of the highest possible level of health
- **Definition:** "HEALTH is a state of COMPLETE physical, mental and social well-being and not merely the ABSENCE of disease or infirmity"
(*Constitution, 1948*)





PEOPLE

Last but not least, WHO is people. Over 8000 public health experts including doctors, epidemiologists, scientists, managers, administrators and other professionals from all over the world work for WHO in 147 country offices, six regional offices and at the headquarters in Geneva, Switzerland.



When diplomats met in San Francisco to form the United Nations in 1945, one of the things they discussed was setting up a global health organization. WHO's Constitution came into force on 7 April 1948 – a date we now celebrate every year as World Health Day.

Delegates from 53 of WHO's 55 original member states came to the first World Health Assembly in June 1948. They decided that WHO's top priorities would be malaria, women's and children's health, tuberculosis, venereal disease, nutrition and environmental sanitation – many of which we are still working on today. WHO's work has since grown to also cover health problems that were not even known in 1948, including relatively new diseases such as HIV/AIDS.

1948

International Classification of Disease
WHO took over the responsibility for the International Classification of Disease (ICD), which dates back to the 1850s and was first known as the International List of Causes of Death. The ICD is used to classify diseases and other health problems and has become the international standard used for clinical and epidemiological purposes.

1952 Dr Jonas Salk (US) develops the first successful polio vaccine.

1967 South African surgeon Christiaan Barnard conducts the first heart transplant.



1952–1964

Global yaws control programme

One of the first diseases to claim WHO's attention was yaws, a crippling and disfiguring disease that afflicted some 50 million people in 1950. The global yaws control programme, fully operational between 1952–1964, used long-acting penicillin to treat yaws with one single injection. By 1965, the control programme had examined 300 million people in 46 countries and reduced global disease prevalence by more than 95%.

1974 Onchocerciasis control programme



WHO worked for 30 years to eliminate onchocerciasis – or river blindness – from West Africa. 600 000 cases of blindness have been prevented and 18 million children spared from the disease. Thousands of farmers have been able to reclaim 25 million hectares of fertile river land that had been abandoned because of the risk of infection.

1974 The World Health Assembly adopts a resolution to create the Expanded Programme on Immunization to bring basic vaccines to all the world's children.

1977 The first Essential Medicines List appeared in 1977, two years after the World Health Assembly introduced the concepts of "essential drugs" and "national drug policy". 156 countries today have a national list of essential medicines.

1979

Eradication of smallpox

The eradication of smallpox – a disease which had maimed and killed millions – in the late 1970s is one of WHO's proudest achievements. The campaign to eradicate the deadly disease throughout the world was coordinated by WHO between 1967 and 1979. It was the first and so far the only time that a major infectious disease has been eradicated.



Mr Ali Maalin (left), from Somalia, was the last person known to be infected with smallpox. Here he stands with the doctor who treated him more than 25 years ago. Ali has since worked on polio eradication campaigns.

1983 Institut Pasteur (France) identifies HIV.

2003

WHO Framework Convention on Tobacco Control

21 May 2003 was a historic day for global public health. After nearly four years of intense negotiations, the World Health Assembly unanimously adopted WHO's first global public health treaty. The treaty is designed to reduce tobacco-related deaths and disease around the world.

2004 Adoption of the Global Strategy on Diet, Physical Activity and Health.



1978 The International Conference on Primary Health Care, in Alma-Ata, Kazakhstan sets the historic goal of "Health for All" – to which WHO continues to aspire.



1988

Global Polio Eradication Initiative established

Since its launch in 1988, the Global Polio Eradication Initiative has reduced the number of cases of polio by more than 99% – from more than 350 000 per year to 1956 in 2006. Spearheaded by national governments, WHO, Rotary International, the US Centers for Disease Control and Prevention and UNICEF, it has immunized more than two billion children thanks to the mobilization of more than 20 million volunteers and health workers. As a result, five million children are today walking, who would otherwise have been paralysed, and more than 1.5 million childhood deaths have been averted.

THE GOAL IS TO ERADICATE POLIO WORLDWIDE SO THAT NO CHILD WILL EVER AGAIN BE PARALYZED BY THIS DISEASE.

2003 Severe Acute Respiratory Syndrome (SARS) first recognized and then controlled.

2005 World Health Assembly revises the International Health Regulations.

World Health Organization



The International Agency for Research on Cancer (**IARC**)

- coordinates and conducts experimental and epidemiological research on the causes of cancer and the mechanisms involved in carcinogenesis; and
- develops evidence-based strategies for cancer prevention and control.

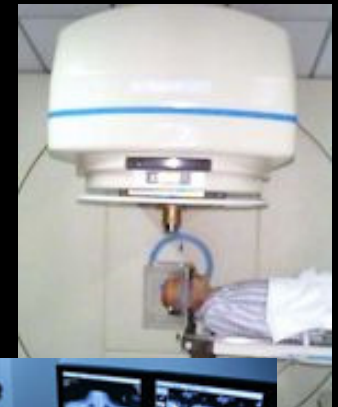
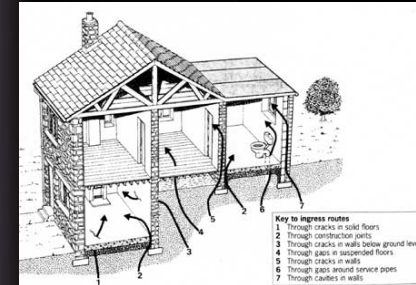
POWER LINES



RADAR



TRAINS



0 Hz 10^2 10^4 10^6 10^8 10^{10} 10^{12}

FREQUENCY (Hz OR CYCLES PER SECOND)



VISIBLE LIGHT



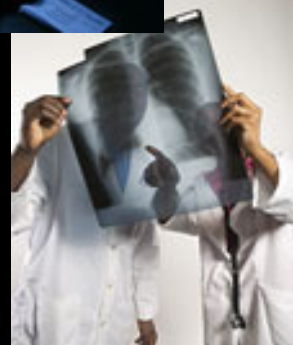
X-RAY



PERSONAL COMPUTER

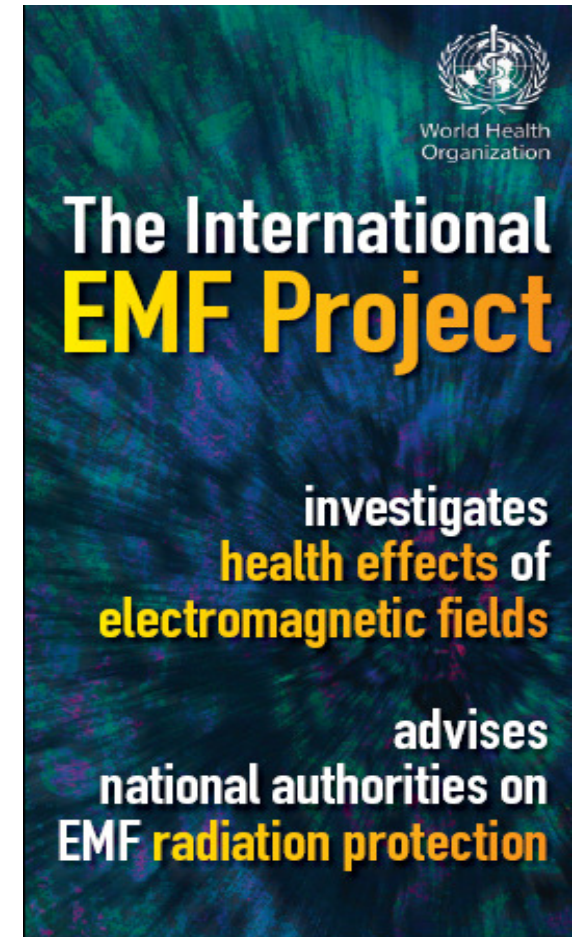


CELL PHONE



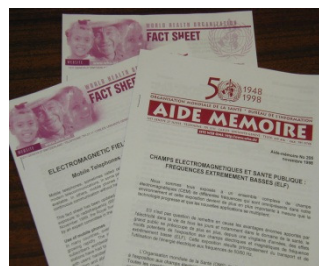
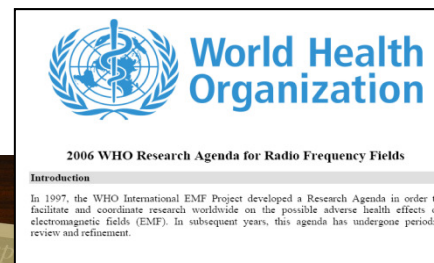
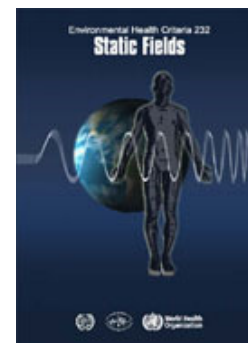
WHO International EMF Project

- Established in 1996
- Coordinated by WHO HQ
- Objectives
 - Review the scientific literature on health effects of EMF exposure and formally assess health risks;
 - Promote a focused agenda of high quality EMF research;
 - Encourage internationally acceptable harmonized standards;
 - Provide information on risk perception, risk communication, risk management



EMF: An Environmental Risk?

Risk Assessment The Evidence

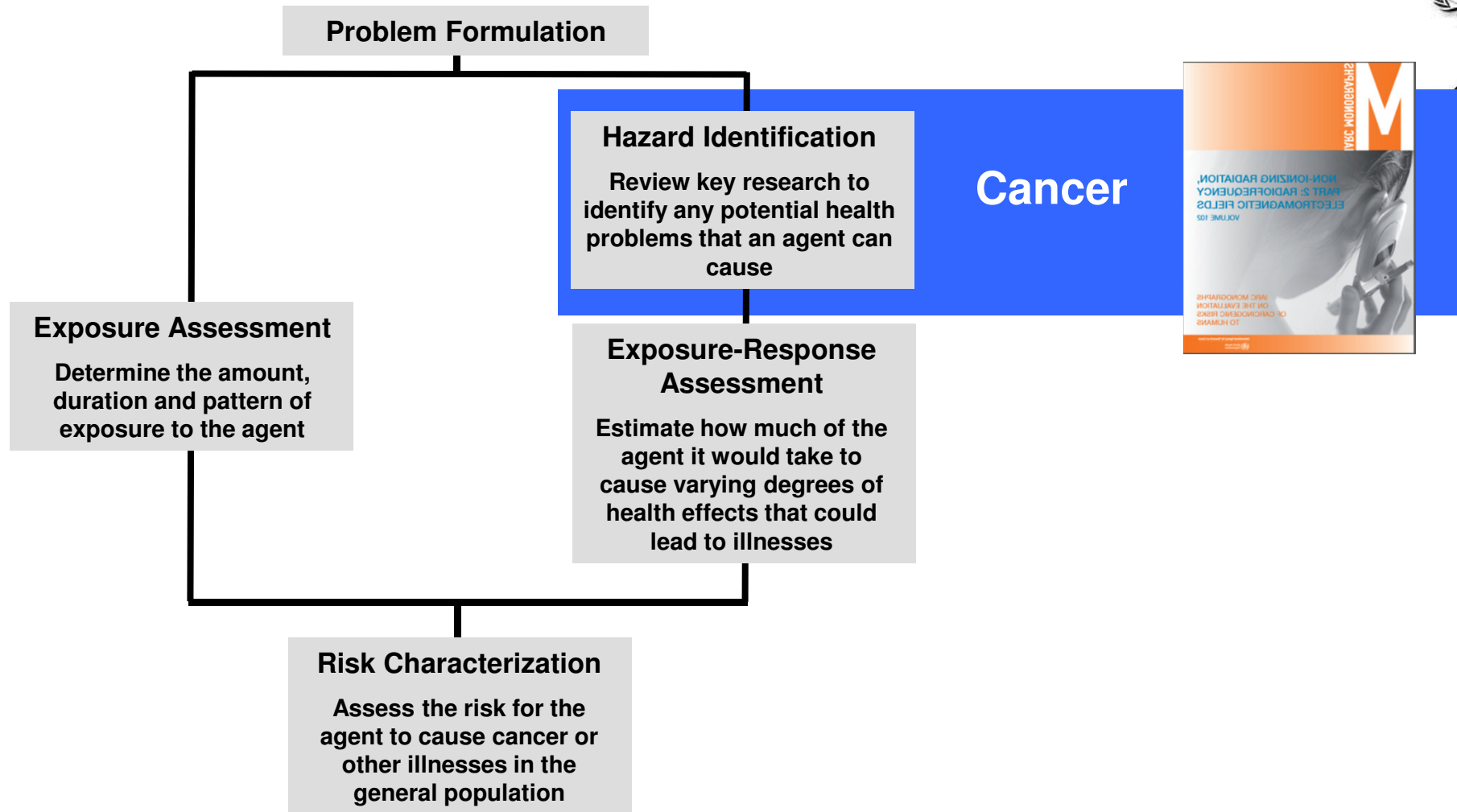


Risk Perception The Public Concern

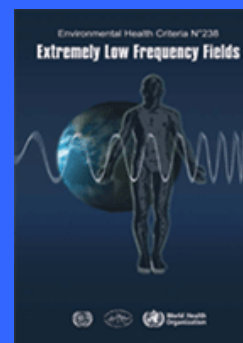
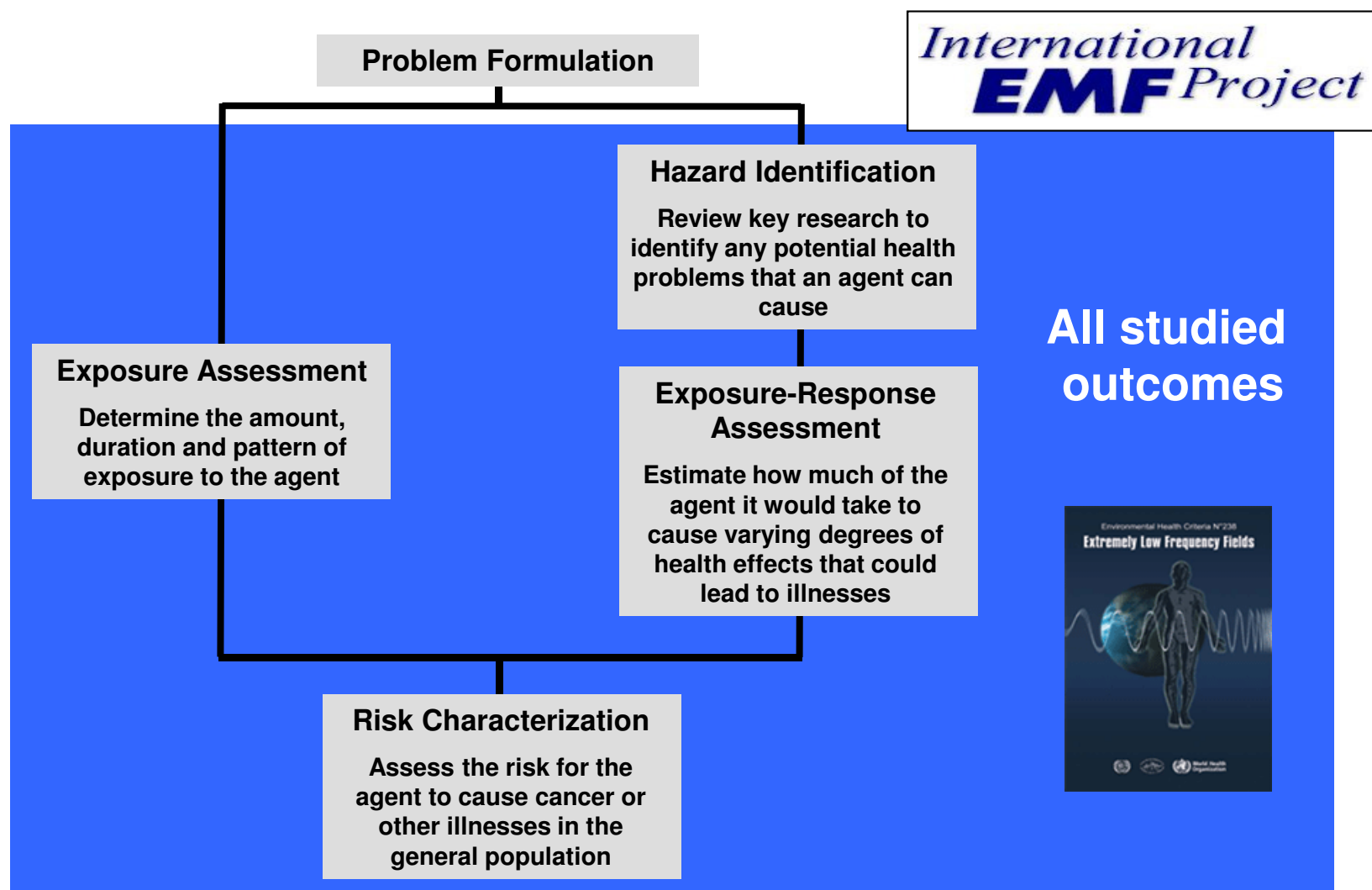
Risk Management The Policies



Health Risk Assessment



Health Risk Assessment (cont'd)



Background

IARC Monographs

International Agency for
Research on Cancer (IARC)

Centre International de
Recherche sur le Cancer (CIRC)

- Initiated in 1969
- Criteria established in 1971, last update January 2006
<http://monographs.iarc.fr/ENG/Preamble/index.php>
- Limited largely to the first step in risk assessment
- “Carcinogen”: exposure that is capable of increasing the incidence of malignant neoplasms (at any stage of the carcinogenesis)
- 970+ agents have been evaluated
- Volume 80: **Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields, 2002**
- Volume 102: **Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, 2013**



Background

IARC Classification

International Agency for
Research on Cancer (IARC)

Centre International de
Recherche sur le Cancer (CIRC)

- For each type of cancer, classify human and animal data separately as:

- Sufficient
- Limited
- Inadequate
- Lack of effect

Group 1: Is carcinogenic to humans

Group 2A: Probably is carcinogenic

Group 2B: Possibly is carcinogenic

Group 3: Not classifiable

Group 4: Is probably not carcinogenic



Background

WHO Environmental Health Criteria

- Original impetus for the Programme came from World Health Assembly resolutions and the recommendations of the 1972 UN Conference on the Human Environment
- Subsequently the work became an integral part of the International Programme on Chemical Safety (IPCS), including UNEP, ILO and WHO
- The EHC monographs have become widely established, used and recognized throughout the world



The International Programme on Chemical Safety (IPCS)



☐ All WHO
☐ This site only

- IPCS Home
- Chemicals assessment
- Methods for chemicals assessment
- Chemicals in food
- Poisons information, prevention and management
- Chemical incidents and emergencies
- Capacity building

Publications | About IPCS | Events

[International Programme on Chemical Safety](#) > [Publications](#)

Environmental Health Criteria

Environmental Health Criteria (EHC) documents provide international, critical reviews on the effects of chemicals or combinations of chemicals and physical and biological agents on human health and the environment.

Each EHC follows a standard outline or format, and you can expect to find a summary of the whole document followed by information on identity, sources of exposure, environmental transport, distribution and transformation, environmental levels and human exposure, kinetics and metabolism in laboratory animals and humans, effects on laboratory animals and in vitro test systems. Effects on humans; effects on other organisms in the laboratory and field. An overall evaluation and conclusions for the protection of human health and the environment is found at the end of each document together with needs for further research and details of previous evaluations by international bodies e.g. IARC, JEFCA.

Two different series of Environmental Health Criteria (EHC) documents are available: (1) on specific chemicals or groups of related chemicals; and (2) on risk assessment methodologies. Both are accessible from the numerical listing below. In addition the EHCs on risk assessment methodologies are accessible from the listing of all IPCS methodology publications and projects.

ACCESS TO ENVIRONMENTAL HEALTH CRITERIA DOCUMENTS

[List of EHCs in numerical order](#)

[List of EHCs \(on chemicals or groups of chemicals\) in alphabetical order](#)

[List of EHCs and other IPCS publications and projects on risk assessment methodologies](#)

NEW PUBLICATIONS

CICADS

CICAD 68
Tetrachloroethene
[Download \[pdf 1.20Mb\]](#)

CICAD 67
2-Butoxyethanol
[Download \[pdf 784kb\]](#)

PESTICIDES

[The WHO Recommended Classification of Pesticides by Hazard](#)

PREVENTION

[Guidelines on the prevention of toxic exposures](#)

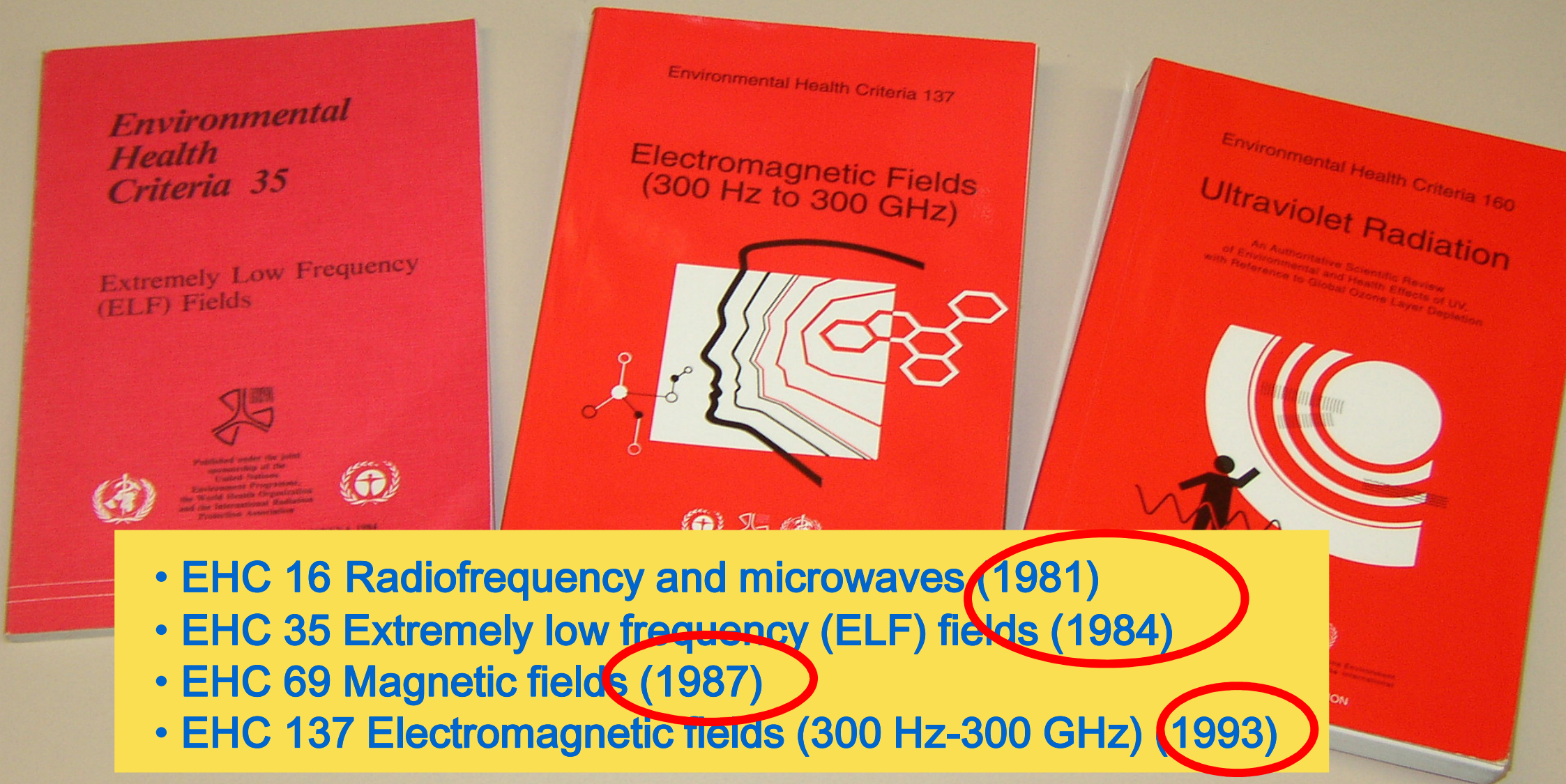
Contact us

Click [here](#) to sign up for updates to the site about selected topics of interest.

Mailing address:
IPCS

Environmental Health Criteria

Electromagnetic Fields



EMF EHC Monographs

Comprise:

- Critical review of evidence for EMF effects on health
- Health risk assessment
- Risk management measures
- Research recommendations



Environmental Health Criteria

- **Target audience**

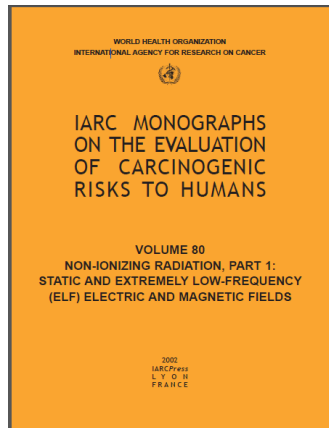
- National and international authorities

- **Reason for development**

- To assist them in making risk assessment and subsequent risk management decisions
- Mandate
- Update



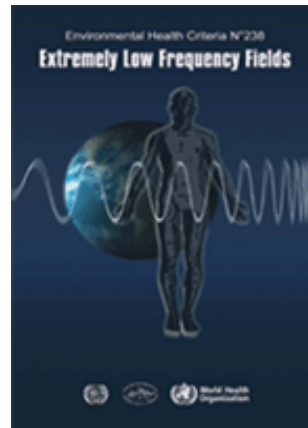
WHO Monographs on Electromagnetic fields



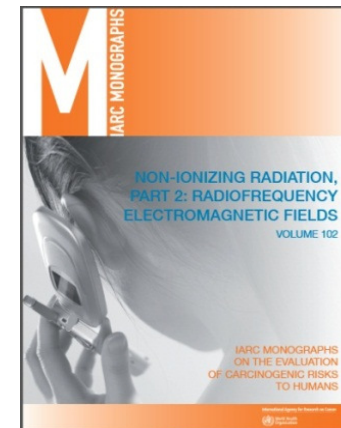
2002



2006



2007



2013



2012-16



RF EHC

INTERPHONE multinational
epidemiologic study (May 2010)

IARC evaluation of **carcinogenic**
risks to humans from RF (May 2011)

WHO assessment of all
health risks to humans from RF
(2012–15)



IARC Monographs on RF

- **Volume 102: Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, 2013**

- Expert meeting, May 2011
- *The Lancet Oncology*, 22 June 2011
- Monograph publication, 24 April 2013

www.thelancet.com/oncology Published online June 22, 2011 DOI:10.1016/S1470-2045(11)70147-4

Carcinogenicity of radiofrequency electromagnetic fields

In May, 2011, 30 scientists from 14 countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to assess the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF). These assessments will be published as Volume 102 of the IARC Monographs.¹

Human exposures to RF-EMF (frequency range 30 kHz–300 GHz) can occur from use of personal devices (eg, mobile telephones, wireless phones,

induced electric and magnetic fields and associated currents inside tissues). The most important factors that determine the induced fields are the distance of the source from the body and the output power level. Additionally, the efficiency of coupling and resulting field distribution inside the body strongly depend on the frequency, polarisation, and direction of wave incidence on the body, and anatomical features of the exposed

regarding associations between use of wireless phones and glioma.

The cohort study⁴ included 257 cases of glioma among 420 095 subscribers to two Danish mobile phone companies between 1982 and 1995. Glioma incidence was near the national average for the subscribers. In this study, reliance on subscription to a mobile phone provider, as a surrogate for mobile phone use, could have resulted in considerable misclassification in



Published Online
June 22, 2011
DOI:10.1016/S1470-
2045(11)70147-4



IARC Evaluation of Radiofrequency Fields

Volume 102 (2013)

- RF fields classified as "*possibly carcinogenic to humans*" (*Group 2B*) based on
 - **limited evidence in humans**, based on positive association between glioma and acoustic neuroma and exposure to RF-EMF from wireless phones (epidemiologic studies)
 - **limited evidence in experimental animals** for the carcinogenicity of RF-EMF
 - **weak mechanistic evidence** relevant to RF-EMF-induced cancer in humans
- Evidence for other exposures (e.g. base stations, Wi-Fi) and outcomes (other cancers) considered insufficient for any conclusion



Agents Classified by IARC (971)

IARC Classification	Examples of Agents
Carcinogenic to humans (114) (usually based on strong evidence of carcinogenicity in humans)	Asbestos Alcoholic beverages Benzene Mustard gas Radon gas Solar radiation Tobacco (smoked and smokeless) X-rays and Gamma
Probably carcinogenic to humans (69) (usually based on strong evidence of carcinogenicity in animals)	Creosotes Diesel engine exhaust Formaldehyde Polychlorinated biphenyls (PCBs)
Possibly carcinogenic to humans (283) (usually based on evidence in humans which is considered credible, but for which other explanations could not be ruled out)	RF fields ELF magnetic fields Coffee Gasoline engine exhaust Pickled vegetables Styrene

6.1 Cancer in Humans

There is *limited evidence* in humans for the carcinogenicity of radiofrequency radiation. Positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma.

6.2 Cancer in Experimental Animals

There is *limited evidence* in experimental animals for the carcinogenicity of radiofrequency radiation.

6.3 Overall Evaluation

Radiofrequency electromagnetic fields are *possibly carcinogenic to humans (Group 2B)*.

6.4 Rationale of the evaluation of the epidemiological evidence

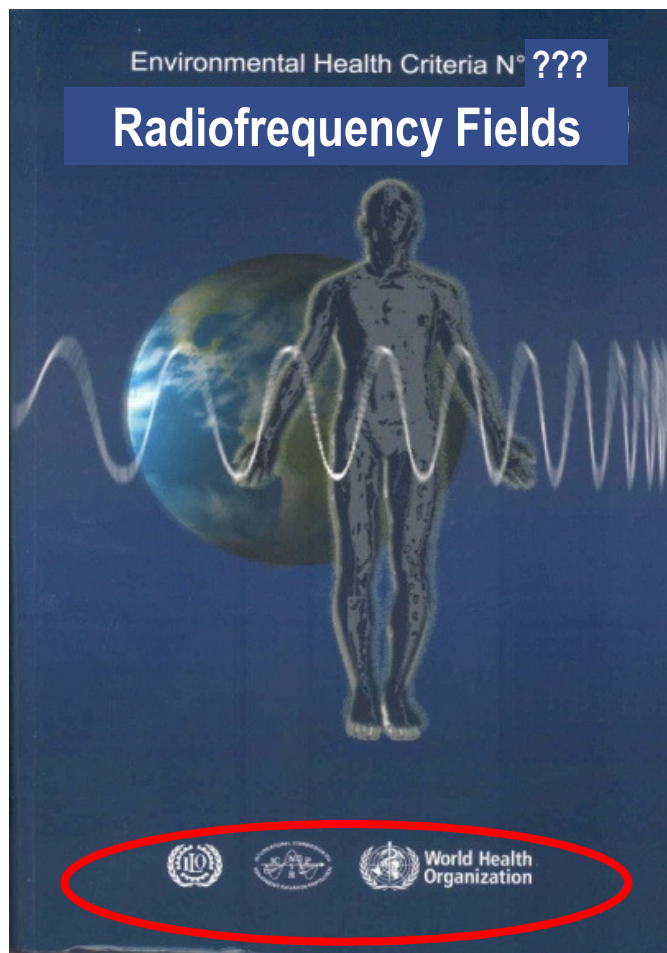
The human epidemiological evidence was mixed. Several small early case-control studies were considered to be largely uninformative. A large cohort study showed no increase in risk of relevant tumours, but it lacked information on level of mobile-phone use and there were several

glioma and acoustic neuroma and mobile-phone use; specifically in people with highest cumulative use of mobile phones, in people who had used mobile phones on the same side of the head as that on which their tumour developed, and in people whose tumour was in the temporal lobe of the brain (the area of the brain that is most exposed to RF radiation when a wireless phone is used at the ear). The Swedish study found similar results for cordless phones. The comparative weakness of the associations in the INTERPHONE study and inconsistencies between its results and those of the Swedish study led to the evaluation of *limited evidence* for glioma and acoustic neuroma, as decided by the majority of the members of the Working Group. A small, recently published Japanese case-control study, which also observed an association of acoustic neuroma with mobile-phone use, contributed to the evaluation of *limited evidence* for acoustic neuroma.

There was, however, a minority opinion that current evidence in humans was *inadequate*, therefore permitting no conclusion about a causal association. This minority saw inconsistency between the two case-control studies



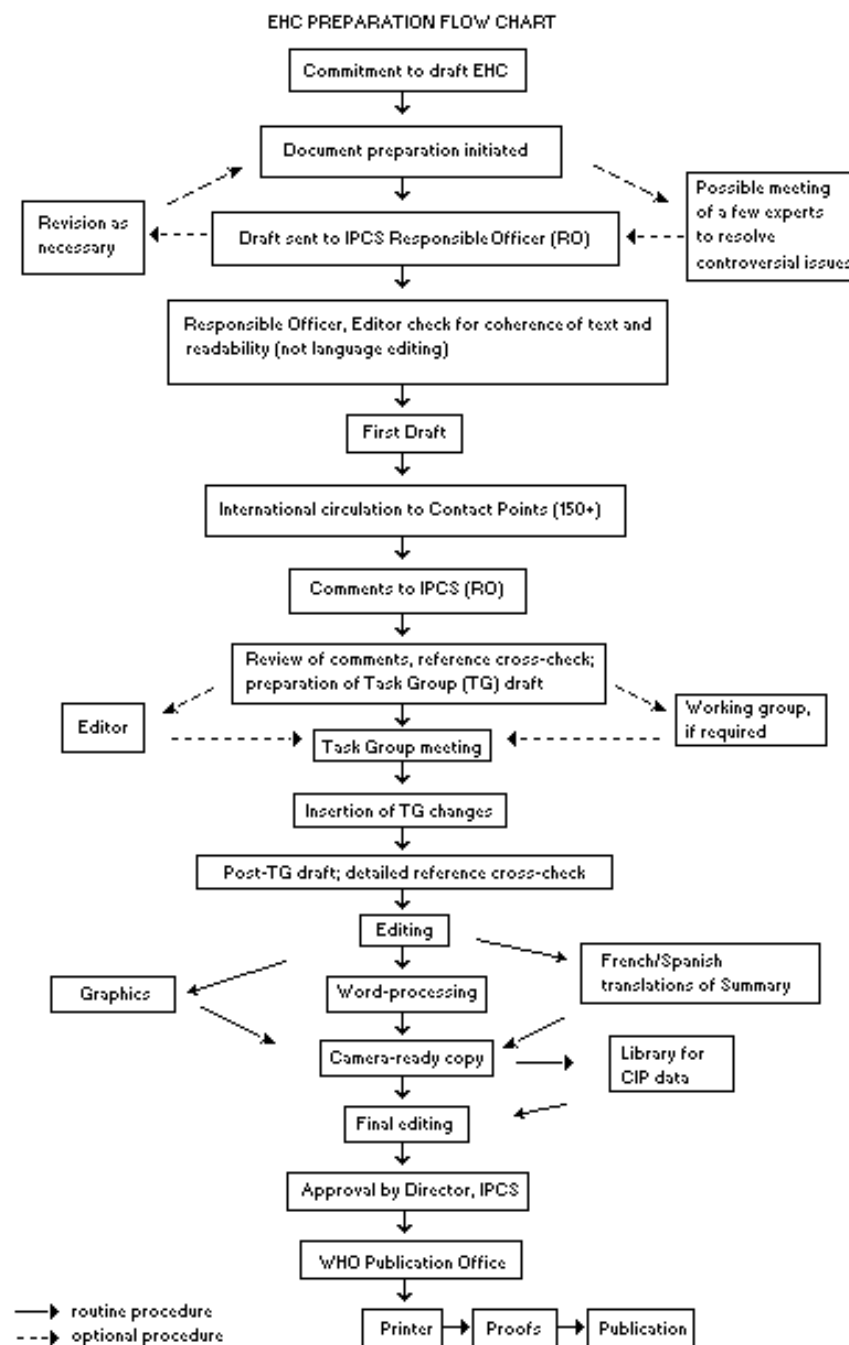
The RF EHC



Scope

- Frequency range:
 - 100 kHz - 300 GHz
 - Include UWB, pulses, mm-waves
- Sources:
 - RFID, EAS, mobile telephony, radars,...
- Health benefits not included
 - Hyperthermia, MRI, medical treatments, diathermy, RF ablation surgery





Kick-off meeting

Jan 2012

**First draft
consultation**

Sept –Dec 2014

**Task Group
meeting**

Fall 2015

**Monograph
publication**
2016



Environmental Health Criteria Contributors

- Chapter authors, expert working group members (~ 25)
- Task Group members
 - Individual scientists, not representatives of their organizations
 - Composition dictated by range of expertise and views, gender and geographical distribution
 - Membership approved by Assistant Director General
 - Role: assess risks to health, reach agreements by consensus, make final conclusions and recommendations that cannot be altered after the Task Group meeting
- Observers
- Secretariat



Core group

- Physics, dosimetry: S. Mann, UK
 - Epidemiological studies: M. Feychting, Sweden
 - Humans studies: G. Oftedal, Norway
 - Animal studies: E. van Rongen, Netherlands
 - In vitro studies: M. R. Scarfi, Italy
 - Public health: D. Zmirou, France
-
- Monthly teleconferences
 - Annual face-to-face meetings



Assistance

- Additional experts to help drafting sections

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Sarah Loughran

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Zenon Sienkiewicz

Myrtill Simko

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Vijaylaxmi

Lawrie Challis (reviewer)



Declaration of Interests

DECLARATION OF INTERESTS FOR WHO EXPERTS

WHO's work on global health issues requires the assistance of external experts who may have interests related to their expertise. To ensure the highest integrity and public confidence in its activities, WHO requires that experts serving in an advisory role disclose any circumstances that could give rise to a potential conflict of interest related to the subject of the activity in which they will be involved.

All experts serving in an advisory role must disclose any circumstances that could represent a potential conflict of

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Code of Conduct for WHO Experts

Should be sent with the DOI form

WHO values and relies upon the normative and technical advice that is provided by leading subject matter experts in the context of similar processes. Such advice contributes to the development of policies and guidelines that are promulgated by WHO for the benefit of the world.

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2. The Undersigned, as a member of the [REDACTED] advisory meeting, group or committee (collectively referred to as the "the Advisory Process"), may have access to the Information in the course of his/her participation in the Advisory Process (whether



EHC on RF Fields

Preamble

1. Summary and recommendations for further study
2. Sources, measurements and exposures
3. Electric and magnetic fields inside the body; SAR and heat
4. Biophysical mechanisms; tissue heating
5. Brain physiology and function
6. Auditory, vestibular and ocular function
7. Neuroendocrine system
8. Neurodegenerative disorders
9. Cardiovascular system and thermoregulation
10. Immune system and haematology
11. Fertility, reproduction and development
12. Cancer
13. Health risk assessment
14. Protective measures

Annexes



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Annexes

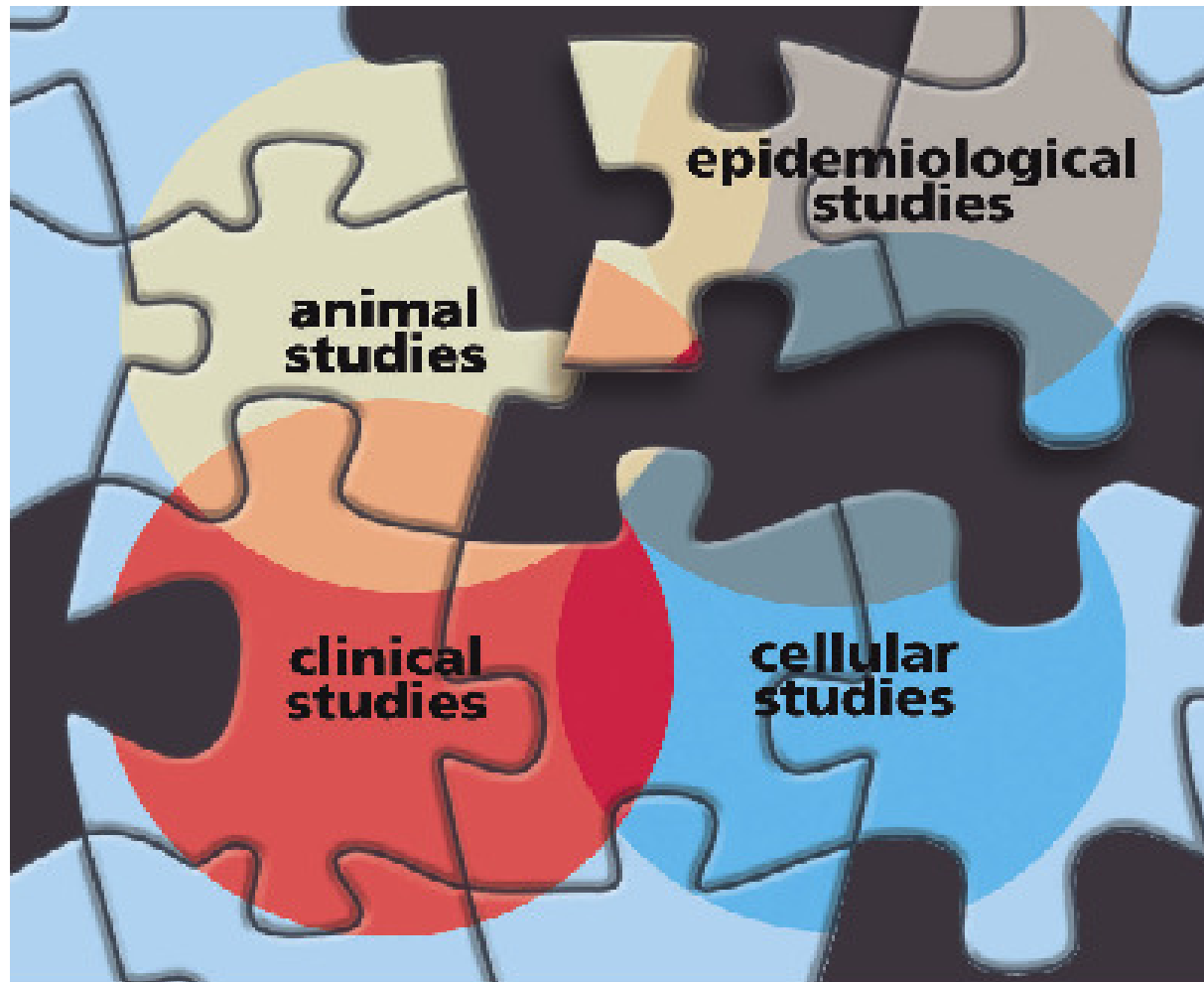


**By disease
category**



Research

Balance of studies needed



<http://www.niehs.nih.gov/emfrapid/booklet/emf2002.pdf>

Relevant studies

- Epidemiological studies
 - Diff. categories of study designs (no case-report or case-series)
- Human studies
 - Laboratory, intervention studies
- Animal studies
 - Laboratory (including ex vivo studies), observational studies (domestic animals)
- In vitro studies
 - Cell cultures, isolated tissue samples



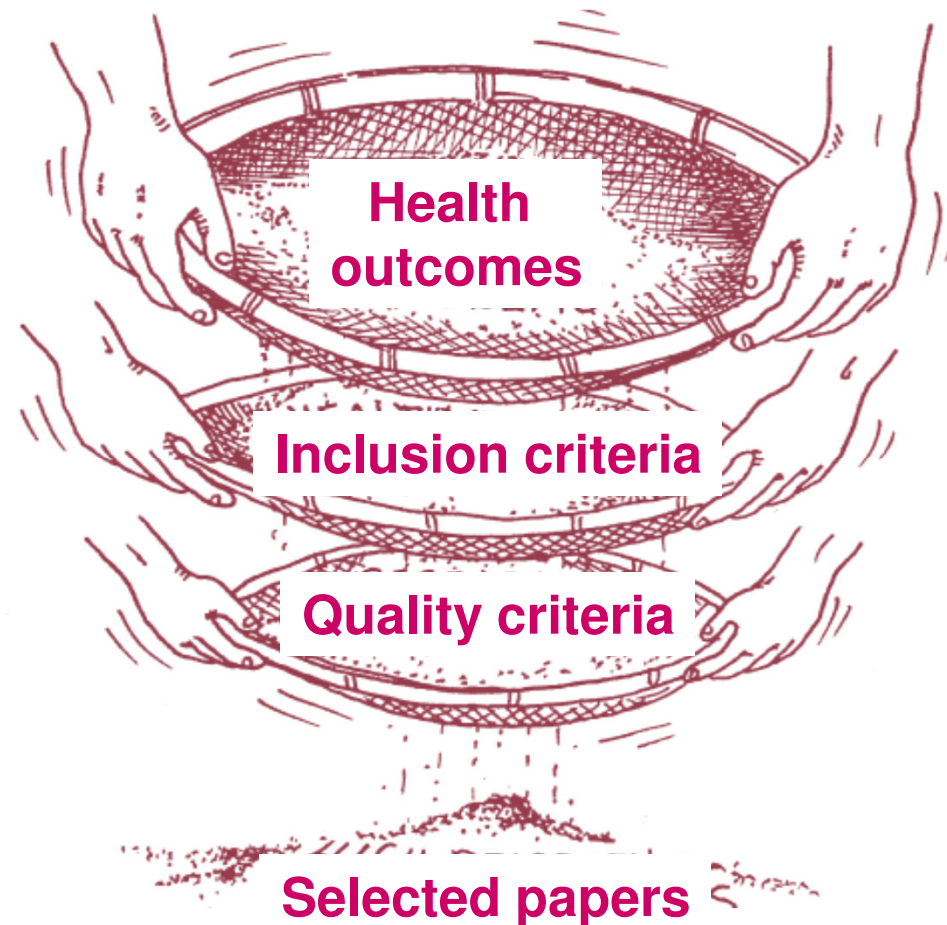
Ch	Topic	Epidemiologic al studies	Human studies	Animal studies	Cellular studies
5	Brain physiology and function	Y	Y	Y	Y
6	Auditory, vestibular and ocular function	Y	Y	Y	Y
7	Neuroendocrine system	Y	Y	Y	-
8	Neurodegenerative disorders	Y	-	Y	Y
9	Cardiovascular system and thermoregulation	Y	Y	Y	-
10	Immune system and haematology	Y	Y	Y	Y
11	Fertility, reproduction and development	Y	Y	Y	Y
12	Cancer	Y	-	Y	Y



Environmental Health Criteria

- Development of an extensive database
 - Peer-reviewed scientific publications
 - Meta-analyses not included at this stage
 - Time period: Jan 1992-Dec 2012
 - Geographical inclusion (UN languages, challenge)

Screening Process



Exposure
+
Specific
outcome



Apply search strategy



Crude list

Screen by title, abstract



Possibly relevant papers, full
text obtained

Remove when not relevant upon
further inspection



Relevant papers

Remove when not compliant
with inclusion criteria



Papers included in Monograph

Apply quality criteria



Papers in full compliance with
inclusion and quality criteria

Epidemiological and volunteer
papers with uncertainties
related to inclusion and quality
criteria

Animal and in vitro papers not
to be included in overall
analysis

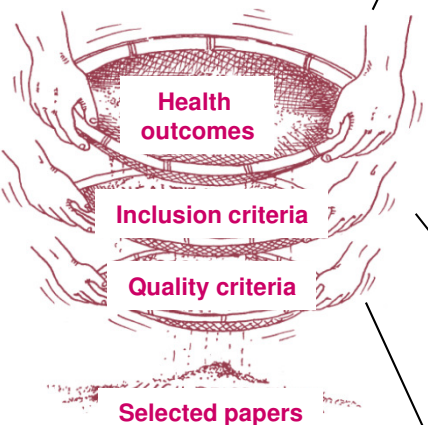
PubMed
ISI Web of Science
Embase
EMF Portal
ELMAR
...



Search for related papers

Search in reference lists

From different topic



Inclusion criteria



- Epidemiological studies
 - Study base identified (to allow assessment of the representativity of the participants)
 - Exposed and unexposed groups considered
 - Relevant statistical analysis performed
- Laboratory studies
 - At least two exposure levels, whereof one could be a sham exposure under otherwise similar conditions
 - Exposure conditions blinded to the participants (human studies only)



Quality criteria

- Epidemiological studies
 - STROBE checklist, GRADE, Newcastle-Ottawa Scale
- Volunteer studies
 - CONSORT statement and checklist, Gold Standard Publication Checklist
- Animal studies
 - Gold Standard Publication Checklist
- In-vitro studies
 - Dosimetry, statistical analysis, T control,...

Quality criteria (cont'd)

- Statistical precision/statistical power (width of confidence intervals when provided, primarily study size)
- Potential biases
- Consistency and plausibility of results and, when relevant, dose-response relationship
- Directness (validity in relation to, e.g. study population, exposure, time lag between exposure and outcome assessment, and endpoints)

Criteria for 'grey zone'

- **Epidemiological studies**

- Insufficient information provided

- **Experimental studies**

- No relevant statistical analysis
- Exposure level not sufficiently controlled and documented

- **Human volunteer studies**

- Exposures given in fixed order
- Insufficient information on blinding of subjects

- **Animal studies**

- Exposures given in fixed order

- **In vitro studies**

- Biological assay not properly carried out



Chapter 1

Summary and Research recommendations

- Executive summary
 - Translated in several UN languages
 - Developed after the Task Group meeting
- Research recommendations
 - Basis for an updated RF Research Agenda (1999, 2003, 2006, 2010)



Chapter 14

Policy measures

Risk Management Policies regarding Radiofrequency Electromagnetic Fields

There has been growing concern about the possibility of adverse health effects resulting from exposure to radiofrequency (RF) electromagnetic fields, such as those emitted by wireless communication devices and networks. In response to such concern, the World Health Organization is assessing health risks that may be associated with exposure to RF fields in the frequency range of 100 kHz to 300 GHz.

This survey seeks to gather information on current risk management policies on RF fields at national level from relevant governmental bodies (e.g. Ministry of Health, Ministry of Environment, Ministry of Telecommunications, Ministry of Labor, Radiation Protection Agency, ...). Please feel free to forward this survey to whom it may concern in your country.

The survey has 3 sections reflecting the following RF exposure categories

- **personal exposures** associated with the use of mobile devices (such as cell phones)
- **environmental exposures** associated with fixed installations transmitting signals from radio, television and wireless communication networks, and
- **occupational exposures** in the telecommunication, industrial and medical sectors

The results of this survey will be made publicly available on WHO's website. If you have questions, please contact us at emfproject@who.int

Thank you in advance for completing this survey by **30 October 2012 (note the extended deadline!!)**.

NOTE: The mention of actions/policies in this survey does not constitute endorsement by WHO that risks exist or that the actions are appropriate. Merely, they represent examples of actions/policies that are in effect or that have been proposed in some countries.

Chapter 14

Policy measures



Announcement of

International Stakeholder Seminar

5 June 2013, 9:00

French Agency for Food
and Occupational Health

27-31 avenue du Général Leclerc

and

Call for examples of good practice

Electromagnetic fields (EMF)

International Stakeholder Seminar on Radiofrequency Policies

French Agency for Food, Environmental and Occupational Health &
Safety (ANSES)
Paris, France, 5 June 2013

Workshop background information

The World Health Organization (WHO) is preparing an Environmental Health Criteria monograph on radiofrequency (RF) fields. The monograph will include a scientific review of all studied health outcomes and it will provide an overview of risk management policies and practices around the world. WHO convened a seminar on 5 June 2013 at the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) in Paris, France, to provide an opportunity for stakeholders to present their views on specific questions to be addressed during the course of this project. The discussions at the seminar and their conclusions will be considered carefully in the development of the WHO monograph.

Share

Print

Table of contents

1. Workshop background information
2. Presentations

Next steps

- 30 September 2014: upload draft chapters on web for public comments for 6 weeks until 31 October 2014
- 15 December 2014: Deadline of expert consultation
- January-March 2015: Core Group review comments and meeting to finalize second draft for Task Group
- Fall 2015: Task Group meeting



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Radio Frequency fields: Environmental Health Criteria Monograph

Consultation on the scientific review for the upcoming WHO Environmental Health Criteria

The consultation is open until 15 December 2014

The World Health Organization is undertaking a health risk assessment of radiofrequency electromagnetic fields, to be published as a monograph in the Environmental Health Criteria Series. This publication will complement the monographs on static fields (2006) and extremely low frequency fields (2007), and will update the monograph on radiofrequency fields (1993).

The draft chapters of this document containing the scientific content are now open for consultation by RF experts. We are seeking comments on the accuracy and completeness of these chapters. Please note that the literature searches have been

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