ITU Workshop on "Practical measurement of EMF exposure"

(Gaborone, Botswana, 25-26 July 2011)

Electromagnetic Fields and Health: A WHO Perspective

Dr E. van Deventer

Radiation Programme

World Health Organization

International Telecommunication Union

OUTLINE

- Introduction
- Assessing the health risk
- Managing the potential risk
- Conclusions

Blood test to diagnose tuberculosis can be dangerous

WHO/Tom Pietrasik

20 July 2011 -- A 12-month analysis reveals that currently available commercial blood tests for diagnosing active TB often lead to misdiagnosis, mistreatment and potential harm to public health. WHO is urging countries to ban these tests and instead rely on accurate microbiological or molecular tests.

Disease outbreak news
Information about disease outbreaks

Emergencies and disasters
Health action in crises

Director-General
Director-General and senior management

Governance
Constitution, Executive Board and World Health Assembly

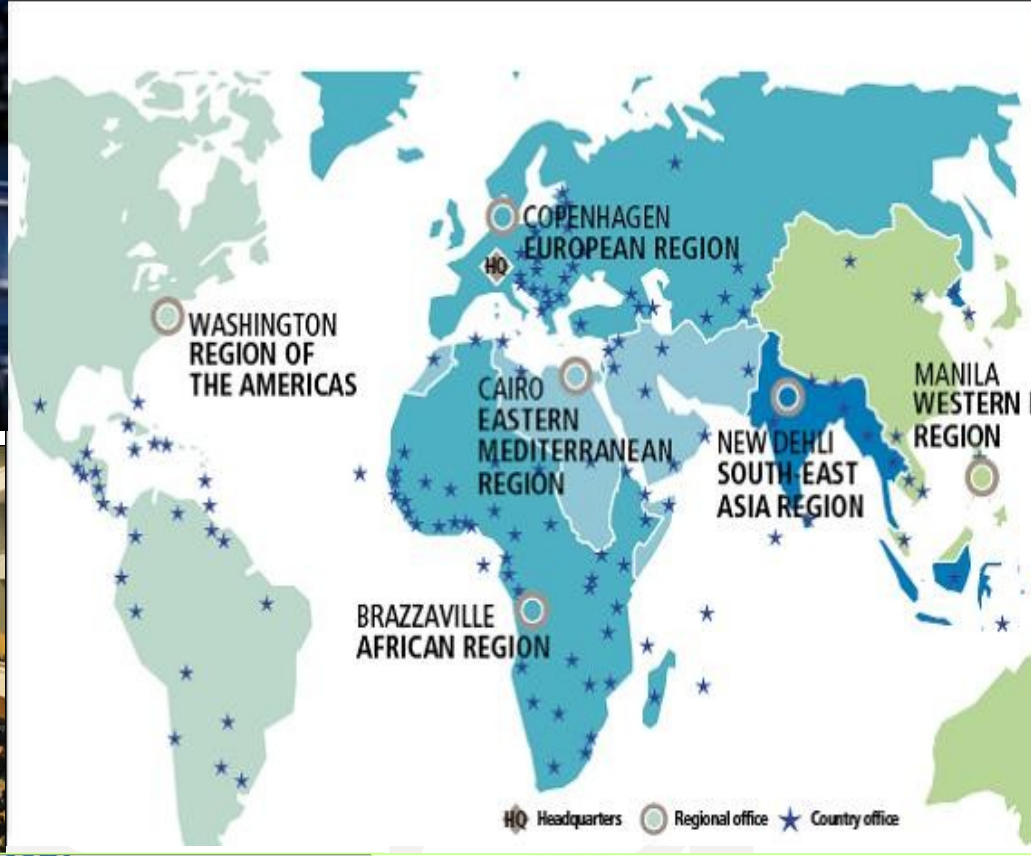
WHO guidelines
A selection of evidence-based guidelines

Blood test to diagnose tuberculosis can be dangerous

Droughts have exhausted coping capacity in the Horn of Africa

Hepatitis C is a global issue

Around 80% of people with West Nile virus have no symptoms



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 programmme

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.

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.

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.

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, Physkal 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.

Non-ionizing radiation

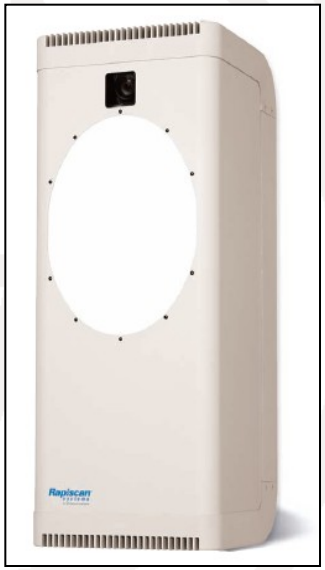
Ionizing radiation

Radio Frequency Fields (100 kHz – 300 GHz)

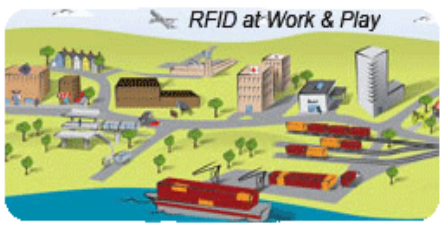
Telecommunications

Residential sources

Commercial



Security scanners



Emerging technologies

Broadcasting

The Present EMF Context

- Increasing EMF human exposure due to electricity demand, medical technologies and wireless devices
- Increasing concern from the public

Daily Mail
24 October 2002
Page 43

Mobiles 'boost cancer'

Radiation may make tumours grow faster

By **Tim Utton**
Science Reporter

NEW safety fears about mobile phones emerged yesterday over a possible link with cancer.

Radiation from the phones could promote the growth of tumours, according to scientists.

A new study suggests the radiation can kick cancer cells into 'high gear' use are still unclear.

The biggest British study, led by Sir William Stewart two years ago, could find no evidence of a risk to health. But Sir William still recommended a precautionary approach, particularly in children.

The World Health Organisation has called for more research and has urged people to limit mobile use.

Now Italian scientists believe they could be closer to the truth.

Dr Fiorenzo Marinelli, of the National Research Council in Bologna, exposed leukaemia cells in the laboratory to 48 hours of continuous radio waves at a similar power and frequency to mobile phone emissions.

Initially, the radiation killed the cancer cells. But then the scientists noticed this lethal effect had gone into reverse as a 'survival mechanism' was triggered, which made them replicate at a ferocious speed.

Dr Marinelli said: 'We don't know what the effects would be on healthy human cells.

'But in leukaemia cells the response is always the same.'

The radiation may initially damage

Cancer develops when control signals in a normal cell go wrong and an abnormal cell results. Instead of destroying itself the mutant cell keeps on dividing and forms a lump or tumour.

The results of the Italian study support the belief of some scientists who say radiation can damage DNA and destroy the cell repair system – making tumours more deadly.

Dr Peter de Pomerai of the University of Nottingham, who studied effects on the body earlier this year, said the research was 'intriguing'.

Radiation may indirectly damage DNA by affecting its repair system, he said. If the DNA repair mechanism does not work as well as it should, mutations in cells could accumulate – with disastrous consequences.

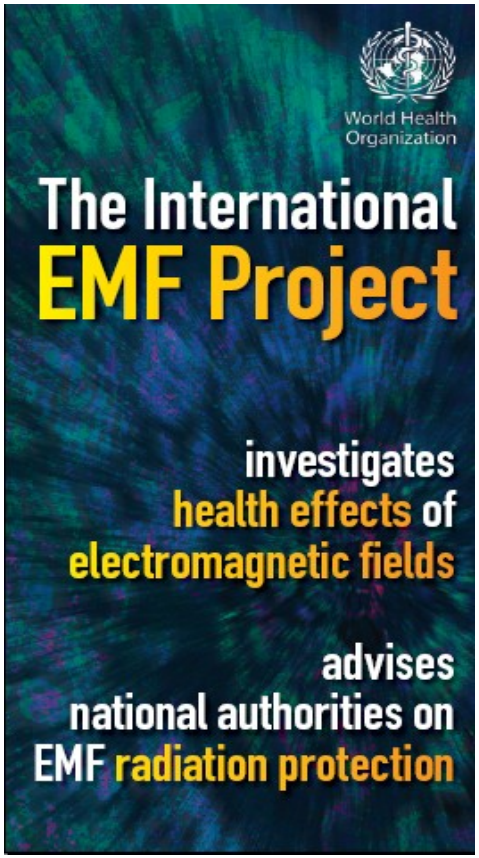
'Cells with unrepaired DNA damage are likely to be far more aggressively cancerous,' said Dr de Pomerai. Dr Marinelli presented his results at the International Workshop on the Biological Effects of Electromag-

The Present Scientific Knowledge

- Large and increasingly sophisticated database
- Known mechanisms
- Health effects not established below international guidelines
- Scientific uncertainty

WHO International EMF Project

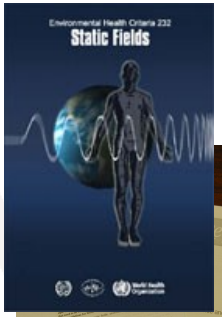
- Established in 1996
- Coordinated by WHO HQ
- A multinational, multidisciplinary effort to create and disseminate information on human health risk from EMF

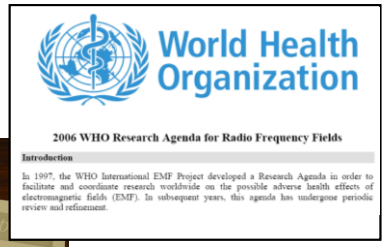


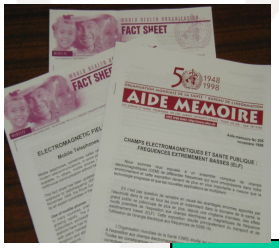
WHO Partners in Radiation

Do EMFs pose a heath risk?

Risk Assessment
The Evidence

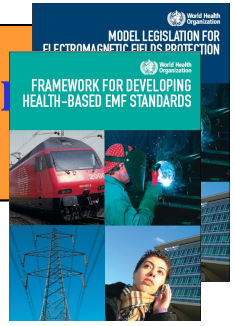






sk Perception
e Public Concern

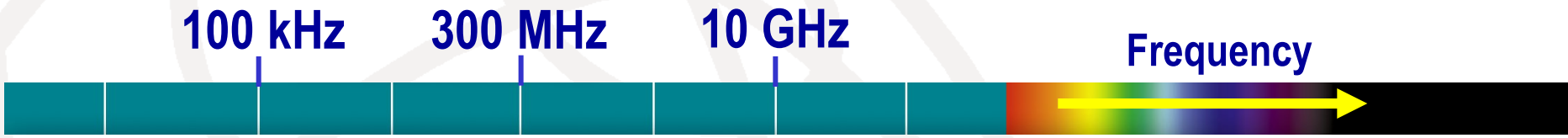
Risk Managemer
The Policies



OUTLINE

- Introduction
- **Assessing the health risk**

What do we know?



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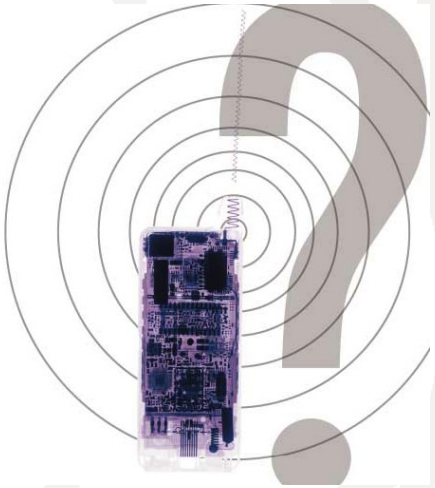
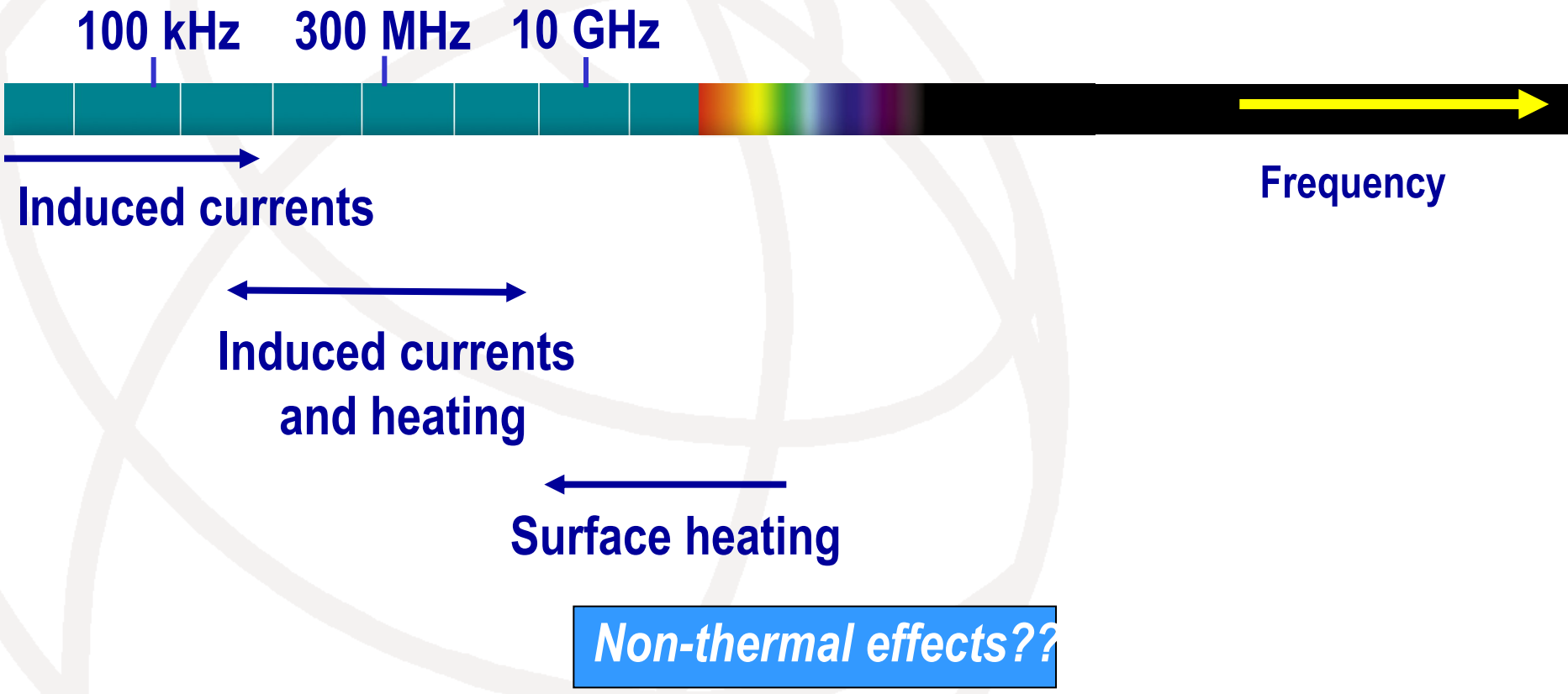
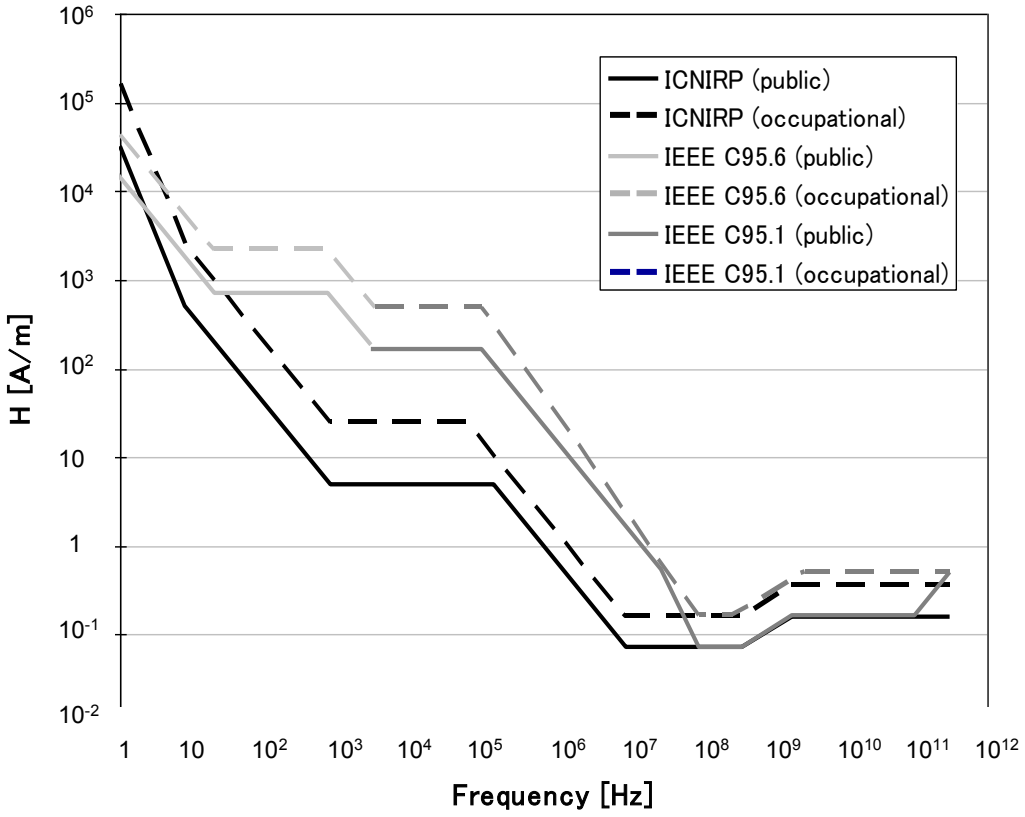


What do we know?

Mechanisms of interaction



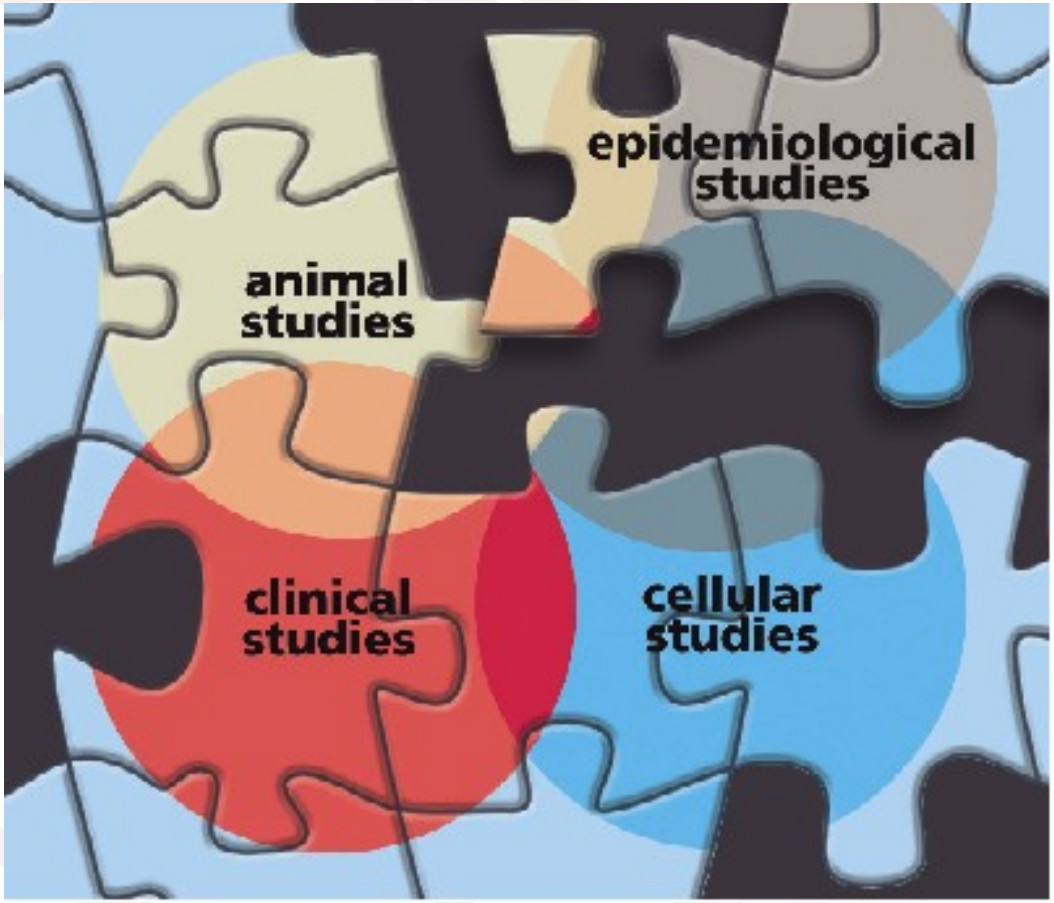
Reference Levels



How do we evaluate the health risk from EMF?

Research

Balance of studies needed



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

RF Studies

(WHO Database, March 2009)

Type of study	Ongoing	Not yet published	Published
Physics	77	14	538
Epidemiology	41	12	311
Human	44	11	256
Animal	42	28	834
Cellular	60	28	503
Total	264	93	2442 !!

Laboratory Studies

- Cellular studies
  - Genotoxicity
  - Gene expression
- Animal studies
  - Cancer
  - Behaviour
  - BBB
  - Skin
- Human studies
  - Sleep
  - EEG
  - Hormones
  - EHS

Short-term effects

(WHO fact sheet 193, June 2011)

- To date, research **does not suggest any consistent evidence** of adverse health effects from exposure to RF fields at levels below those that cause tissue heating.
- Research has not been able to provide support for a causal relationship between exposure to EMF and self-reported symptoms, or "electromagnetic hypersensitivity".

World Health Organization

Fact sheet N°296
December 2005

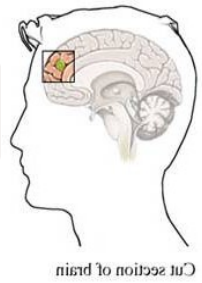
Electromagnetic fields and public health
Electromagnetic Hypersensitivity

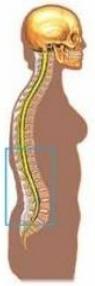
Conclusions: "EHS is characterized by a variety of non-specific symptoms that differ from individual to individual… EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure."

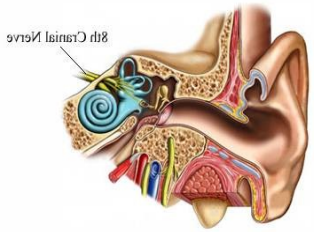
Epidemiology

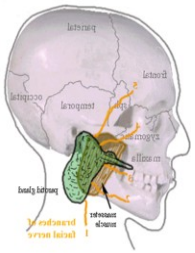
Studies on mobile phones

- Tumours in head and neck
  - Glioma, meningioma, acoustic neuroma, parotid gland









- Around 15 studies on the use of mobile phones
  - Published: USA, Nordic countries, Hardell, INTERPHONE
  - Ongoing: Cefalo, MOBI-Kids, COSMOS

INTERPHONE study
(published 18 May 2010)

Published by Oxford University Press on behalf of the International Epidemiological Association

International Journal of Epidemiology 2010;1–20
doi:10.1093/ije/dyq079

Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study

The INTERPHONE Study Group*

Corresponding author. Elisabeth Cardis; CREAL, Doctor Aiguader 88,
*List of members of this study group is available in the Appendix.

Accepted 8 March 2010

- **Cases:**
  - 2,765 gliomas
  - 2,425 meningiomas
  - 1,121 acoustic neuroma
  - 109 malignant parotid gland
- **Controls:**
  - 7,658

Long-term effects

(WHO fact sheet 193, June 2011)

- No increased risk of glioma or meningioma with mobile phone use of more than 10 years
- Indications of increased risk of glioma for heavy users
  - Biases and errors prevent a causal interpretation.
- No available data for long-term use (15-20 ans)
- No available data for children

World Health Organization

Media centre

Electromagnetic fields and public health: mobile phones

Fact sheet N°193
June 2011

Key facts

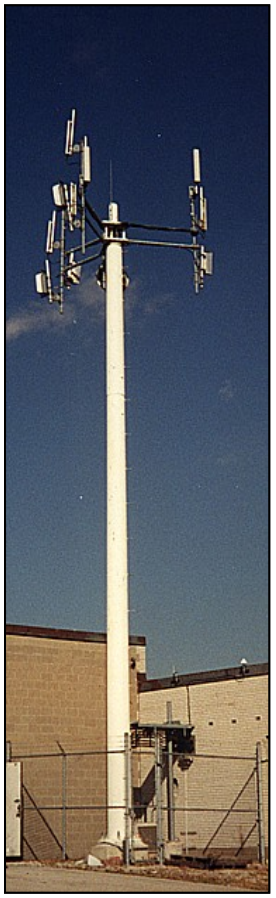
- Mobile phone use is ubiquitous with an estimated 4.6 billion subscriptions globally.
- The electromagnetic fields produced by mobile phones are classified by the International Agency for Research on Cancer as possibly carcinogenic to humans.
- Studies are ongoing to more fully assess potential long-term effects of mobile phone use.
- WHO will conduct a formal risk assessment of all studied health outcomes from radiofrequency fields exposure by 2012.

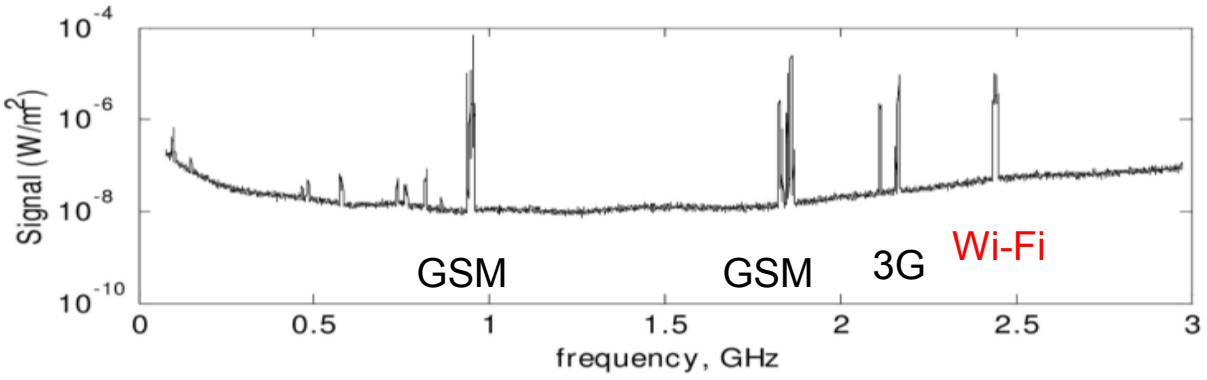
http://www.who.int/mediacentre/factsheets/fs193/en/index.html

Epidemiology

Base stations and wireless networks

- Some studies have been performed
  - Well-being and performance
  - Cancer





Kenneth R. Foster, *Radiofrequency exposure from wireless LANs utilizing WI-FI technology*. Health Phys. 92(3):280 –289; 2007

World Health Organization

Fact sheet N°304
May 2006

Electromagnetic fields and public health
Base stations and wireless technologies

Conclusions:

"Considering the very low exposure levels and research results collected to date, **there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects"**

WHO Health Risk Assessment

Risk assessment
of **all health outcomes**
(Environmental Health Criteria)

International EMF Project

Hazard identification and classification
of possible **carcinogens**
(Monographs)

International Agency for Research on Cancer (IARC)

Centre International de Recherche sur le Cancer (CIRC)

Background
IARC Monographs

International Agency for Research on Cancer (IARC)

Centre International de Recherche sur le Cancer (CIRC)

- The *IARC Monographs* are a series of scientific reviews that identify environmental factors that can increase the risk of human cancer

- National and international health agencies use the *Monographs*
  - As a source of information on potential carcinogens
  - As scientific support to guide their actions to prevent exposure to potential carcinogens

Background

IARC Monographs

International Agency for Research on Cancer (IARC)

Centre International de Recherche sur le Cancer (CIRC)

- Initiated in 1969
- 950+ 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, Working Group meeting 24-31 May 2011*

Overview of the evaluation process

Cancer in humans

Sufficient evidence
Limited evidence
Inadequate evidence
Evidence suggesting lack of carcinogenicity

Cancer in experimental animals

Sufficient evidence
Limited evidence
Inadequate evidence
Evidence suggesting lack of carcinogenicity

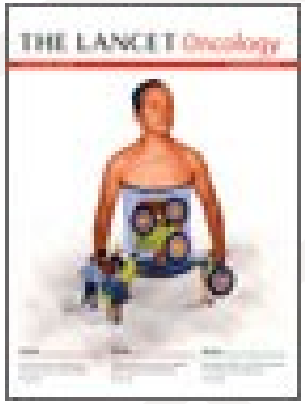
Mechanistic and other relevant data

- Mechanistic data "weak," "moderate," or "strong"?
- Mechanism likely to be operative in humans?

Overall evaluation

Group 1	*Carcinogenic to humans*
Group 2A	*Probably carcinogenic to humans*
Group 2B	*Possibly carcinogenic to humans*
Group 3	*Not classifiable as to its carcinogenicity to humans*
Group 4	*Probably not carcinogenic to humans*

IARC Evaluation
Volume 102 - Radiofrequency Fields



The Lancet Oncology
Volume 12, Issue 7, pp. 624 - 626, July 2011
doi:10.1016/S1470-2045(11)70147-4
Published Online: 22 June 2011

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 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 regarding associations between use of wireless phones and glioma.

The cohort study[4] 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

Published Online
June 22, 2011

Gaborone, Botswana, 25–26 July 2011

IARC Evaluation
Volume 102 - Radiofrequency Fields

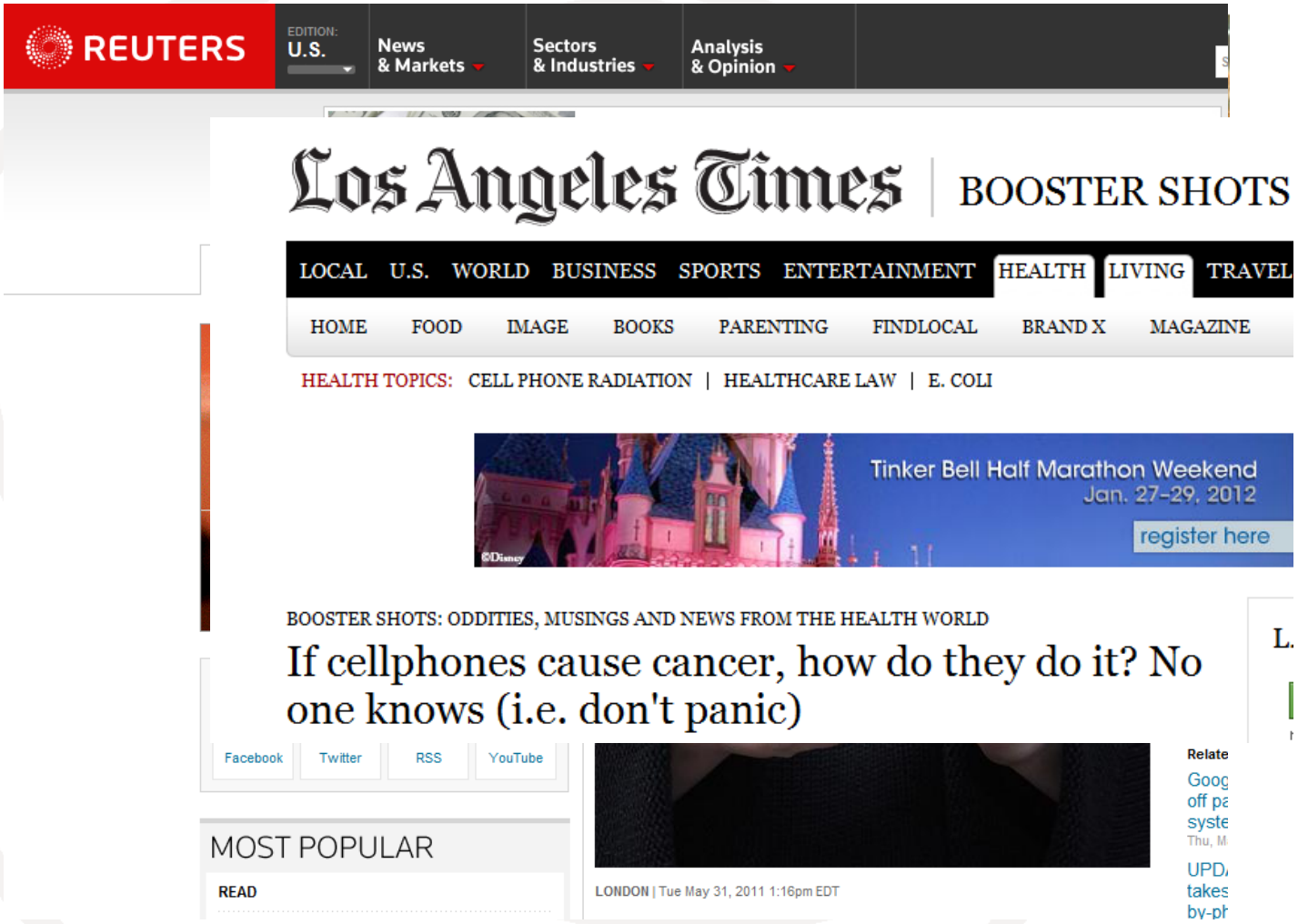
- RF fields classified as **Group 2B "Possible Carcinogenic"** based on
  - **limited** human data on association between glioma and acoustic neuroma and exposure to RF-EMF from wireless phones (epidemiologic studies).
  - **limited** animal data

- Evidence for other exposures (e.g. base stations, wifi, …) and outcomes (other cancers) considered insufficient for any conclusion

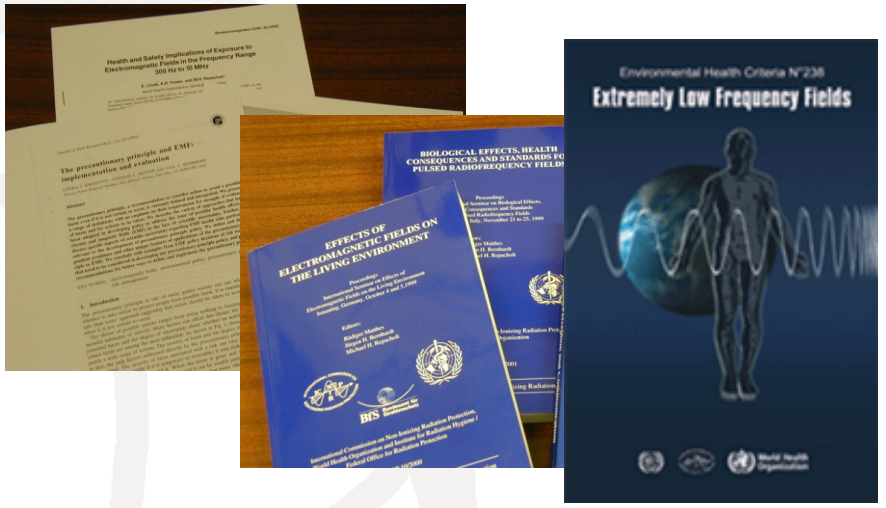
Agents Classified by IARC (950)

IARC Classification	Examples of Agents
Carcinogenic to humans (107) (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 (59) (usually based on strong evidence of carcinogenicity in animals)	**Creosotes** **Diesel engine exhaust** **Formaldehyde** **Polychlorinated biphenyls (PCBs)**
Possibly carcinogenic to humans (267) (usually based on evidence in humans which is considered credible, but for which other explanations could not be ruled out)	**Coffee** **Gasoline engine exhaust** **Pickled vegetables** **ELF magnetic fields** **Styrene** **RF fields**

IARC Classification



WHO and EMF Research



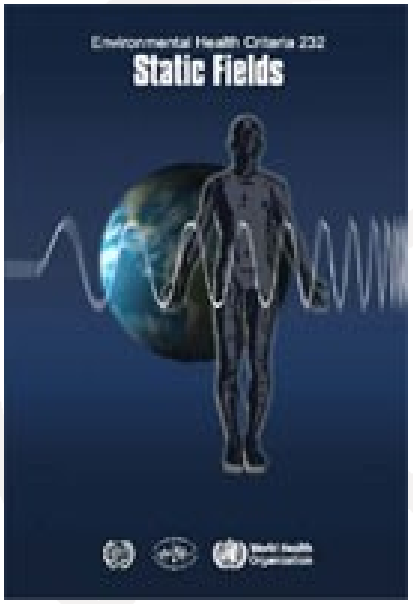
What has been done?

time

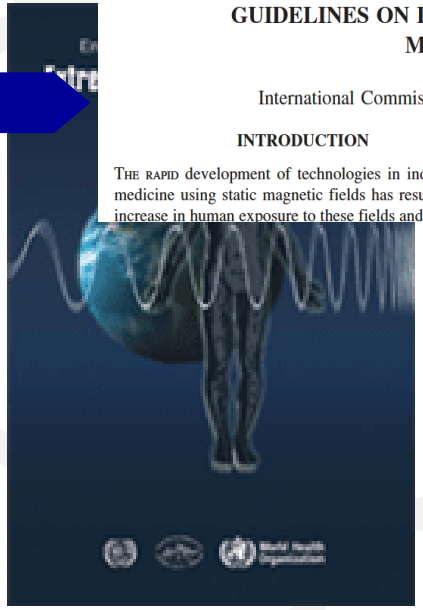
- WHO Research reviews
- Health Risk Assessments

Environmental Health Criteria

Electromagnetic Fields



2006



2007

ICNIRP Guidelines

2009

GUIDELINES ON LIMITS OF EXPOSURE TO STATIC MAGNETIC FIELDS

International Commission on Non-Ionizing Radiation Protection*

INTRODUCTION

THE RAPID development of technologies in indus
medicine using static magnetic fields has resulte
increase in human exposure to these fields and ha

ICNIRP Guidelines

2010

GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS (1 Hz TO 100 kHz)

International Commission on Non-Ionizing Radiation Protection*

INTRODUCTION

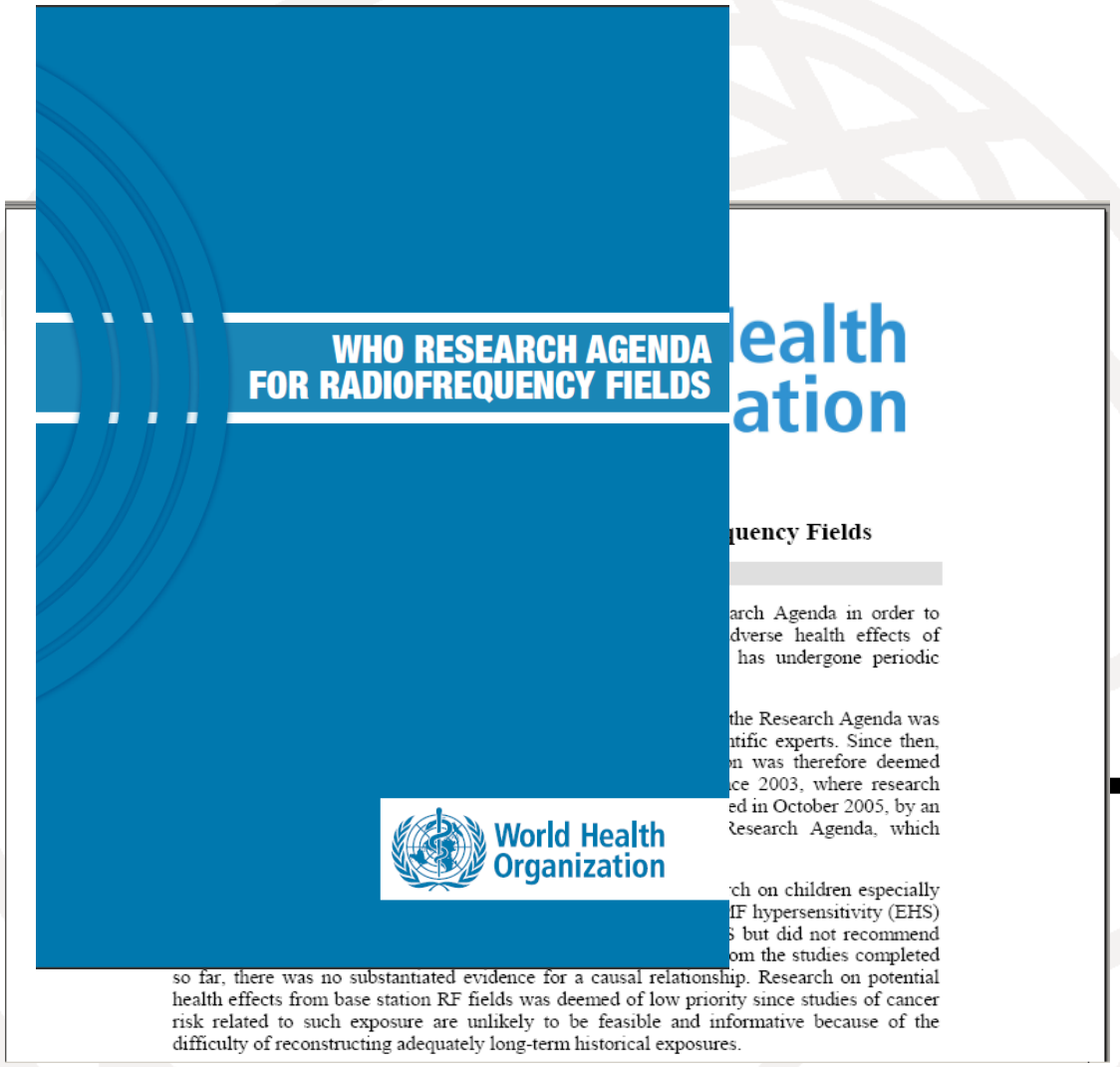
IN THIS document, guidelines are established for the protection of humans exposed to electric and magnetic fields in the low-frequency range of the electromagnetic spectrum.

with a conducting object where the electric potential of the object is different from that of the body. Results of laboratory and epidemiological studies, basic exposure assessment criteria, and reference levels for practical hazard assessment are discussed, and the guidelines presented here are appli-

RF fields

2012

WHO and EMF Research



What needs to been done?

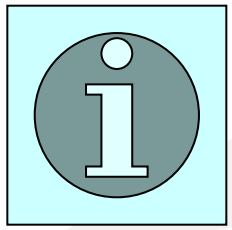
time

WHO Research Agenda

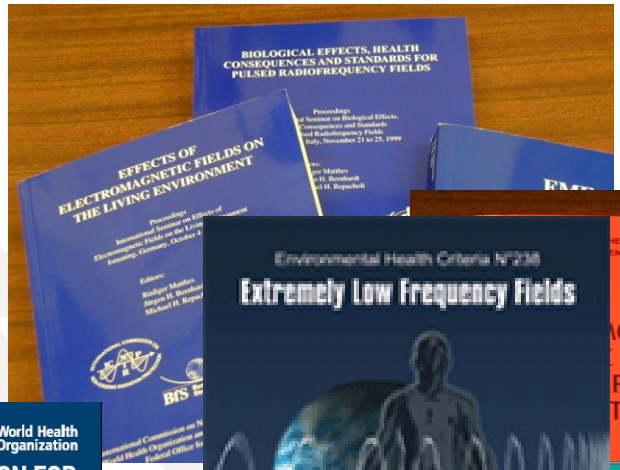
Gaborone, Botswana, 25–26 July 2011

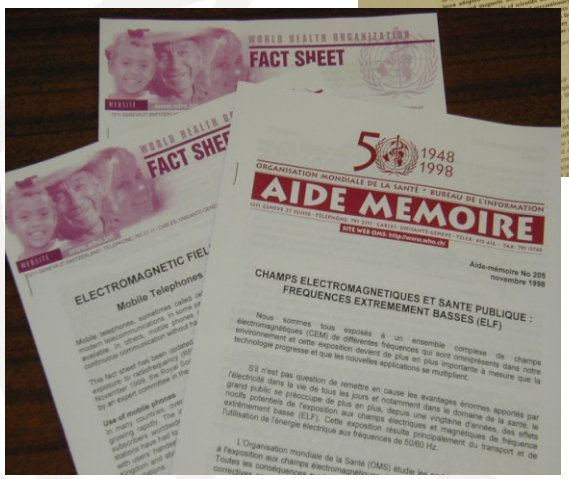
OUTLINE

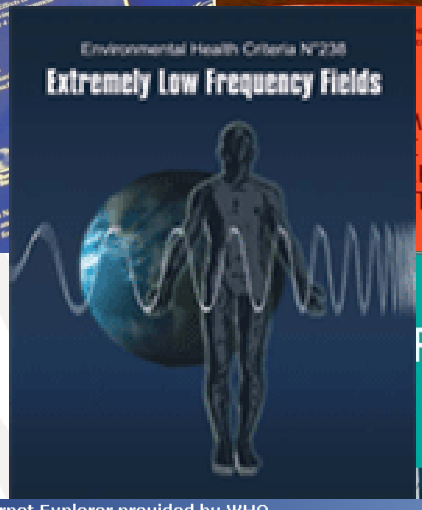
- Introduction
- Assessing the health risk
- **Managing the health risk**
  - **Communicating the scientific knowledge**
  - **Developing standards and regulations**

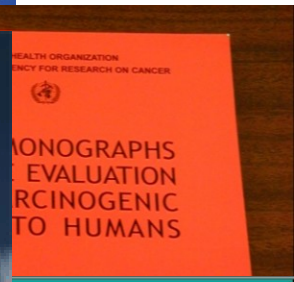



Health and Safety Implications of Exposure to Electromagnetic Fields in the Frequency Range 300 Hz to 30 MHz
The precautionary principle and EMF: implementation and evaluation
cience Reprint
Science and the Precautionary Principle


BIOLOGICAL EFFECTS, HEALTH CONSEQUENCES AND STANDARDS FOR PULSED RADIOFREQUENCY FIELDS
EFFECTS OF ELECTROMAGNETIC FIELDS ON THE LIVING ENVIRONMENT


WORLD HEALTH ORGANIZATION
FACT SHEET
50
1948
1998
AIDE MEMOIRE
ELECTROMAGNETIC FIEL
Mobile Telephones
CHAMPS ELECTROMAGNETIQUES ET SANTE PUBLIQUE : FREQUENCES EXTREMEMENT BASSES (ELF)


Environmental Health Criteria N°238
Extremely Low Frequency Fields


ONOGRAPHS
EVALUATION
RCINOGENIC
TO HUMANS


World Health Organization
MODEL LEGISLATION FOR ELECTROMAGNETIC FIELDS PROTECTION


World Health Organization
FOR DEVELOPING
EMF STANDARDS


ESTABELECENDO UM DIÁLOGO
SOBRE RISCOS DE
CAMPOS ELETROMAGNÉTICOS
ORGANIZAÇÃO MUNDIAL DE SAÚDE


WHO | Electromagnetic fields - Microsoft Internet Explorer provided by WHO
File Edit View Favorites Tools Help
Address http://www.who.int/peh-emf/en/
World Health Organization
Search
All WHO This site only
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About WHO
Countries
Health topics
Publications
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About us | Publications | Contact us
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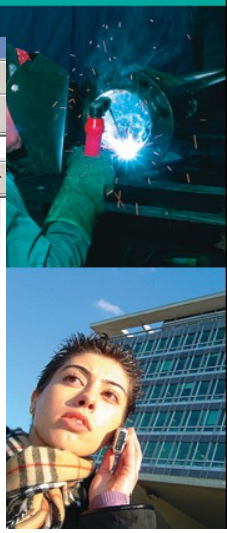
Electromagnetic fields
EMF
Participating countries & entities in EMF Project
WHAT'S NEW!
Fact sheet N°322
Exposure to extremely low frequency fields
Full text
ELF Environmental Health Criteria N°238
Chapters available to download



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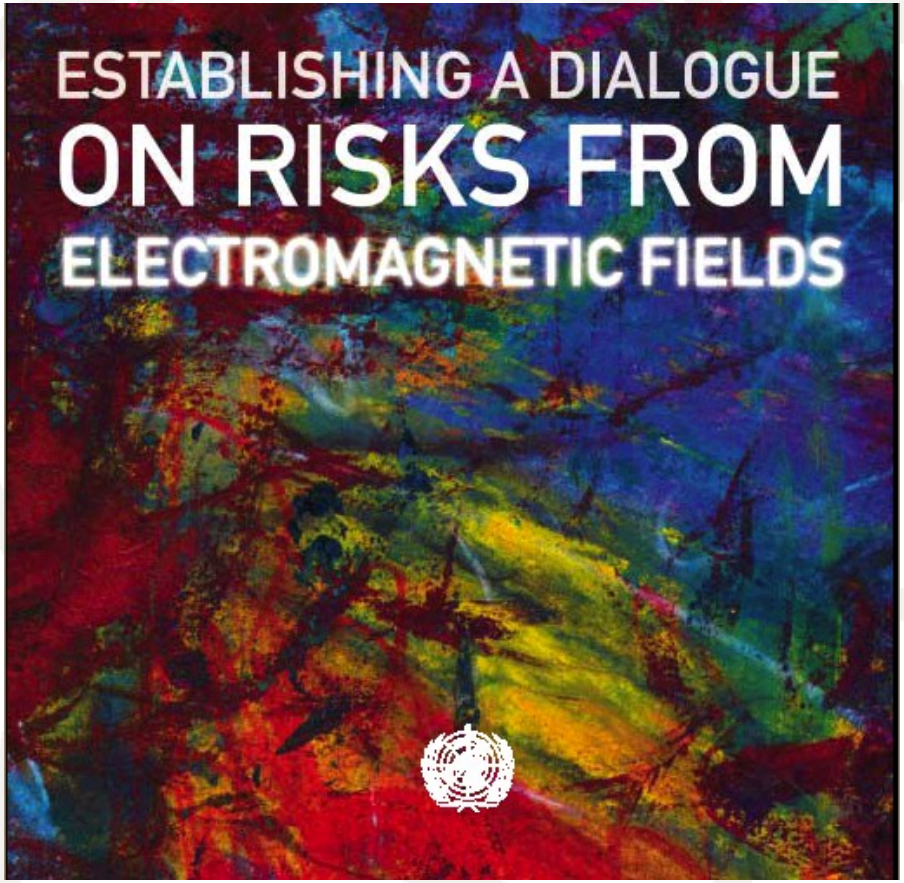
Risk Perception and Communication

WHO Risk Handbook

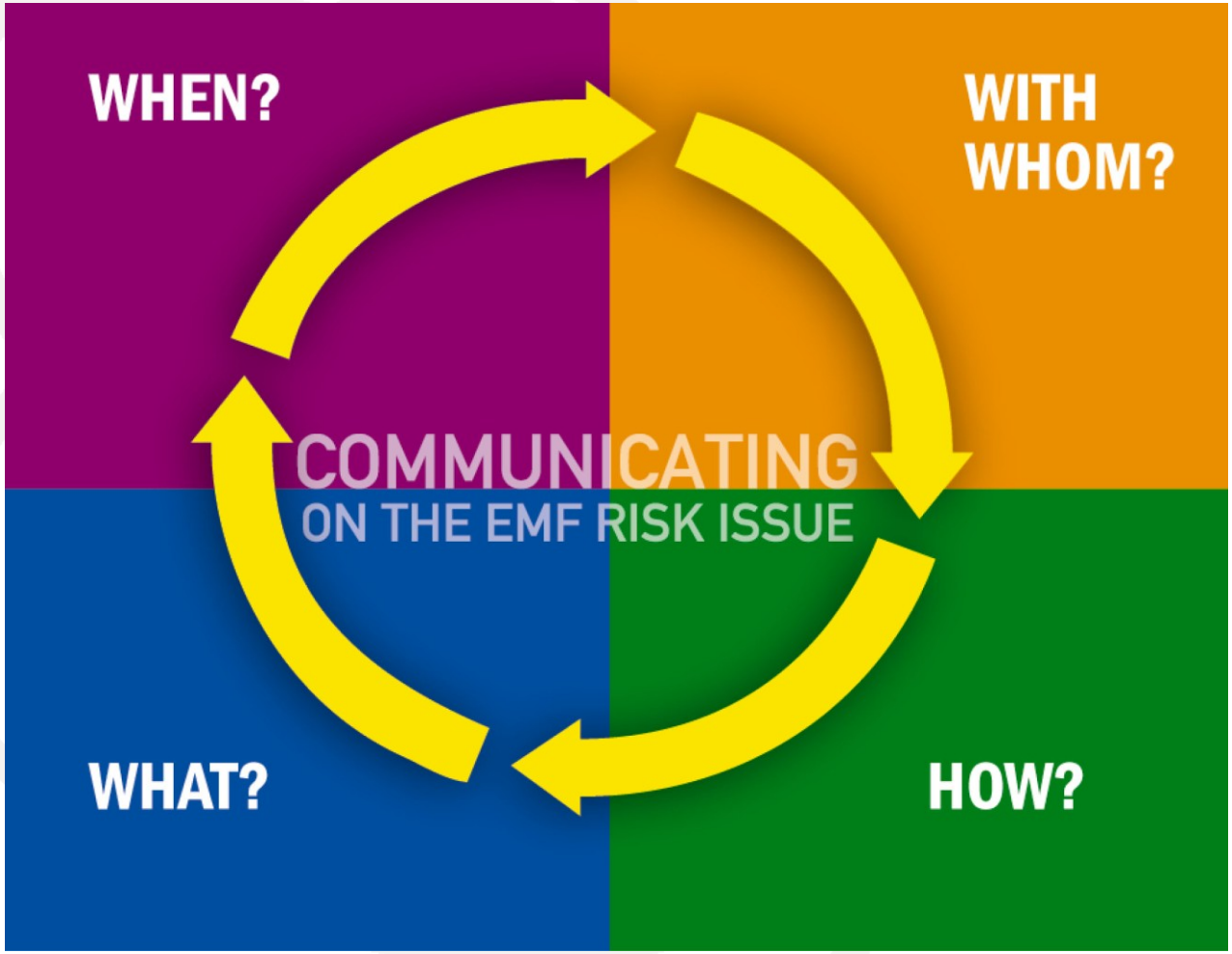


- For programme managers who need basic information on EMF risk perception, communication and management
- Available in English
- Translated into Spanish, Italian, German, French, Russian, Bulgarian, Dutch, Polish, Portuguese, Hungarian and Japanese
- Available on the web www.who.int/emf

Elements of Risk Perception

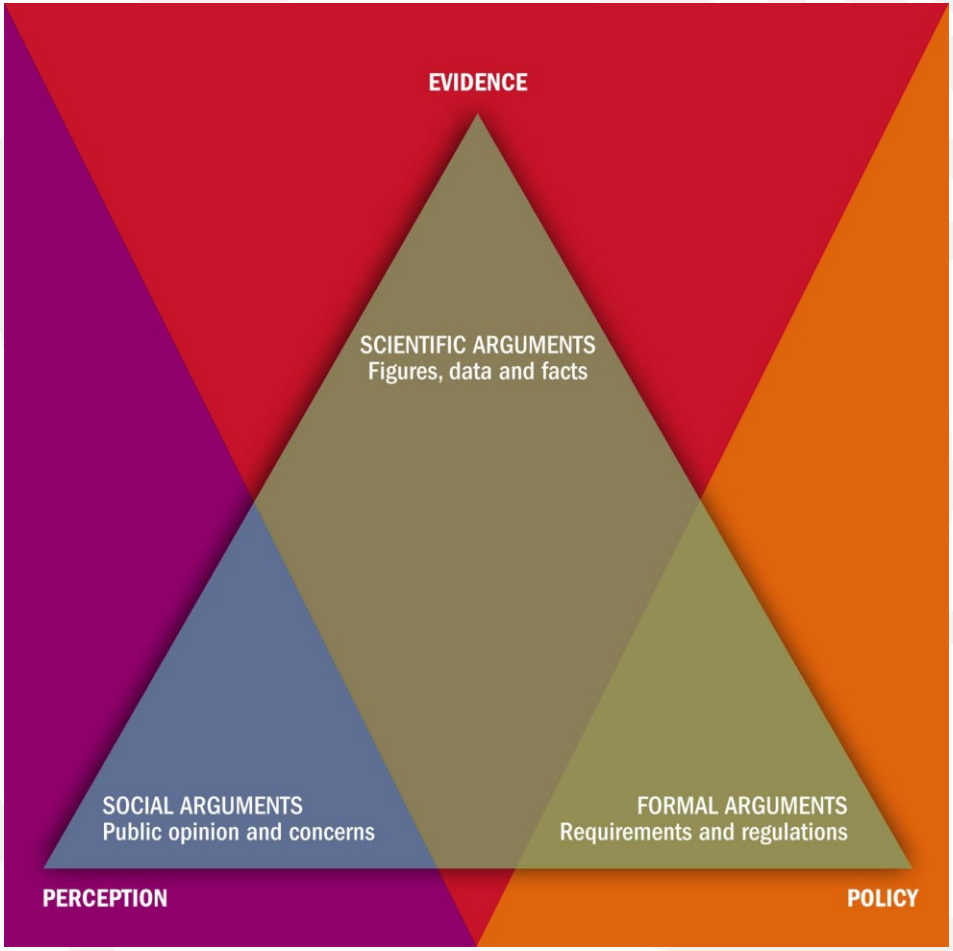
- Extent of health risk
- Probability of occurrence
- Uncertainty
- Ubiquity
- Pattern of exposure
- Delayed effect
- Inequity and injustice
- Voluntary vs. involuntary exposure

Managing EMF Risk Communication



The Message

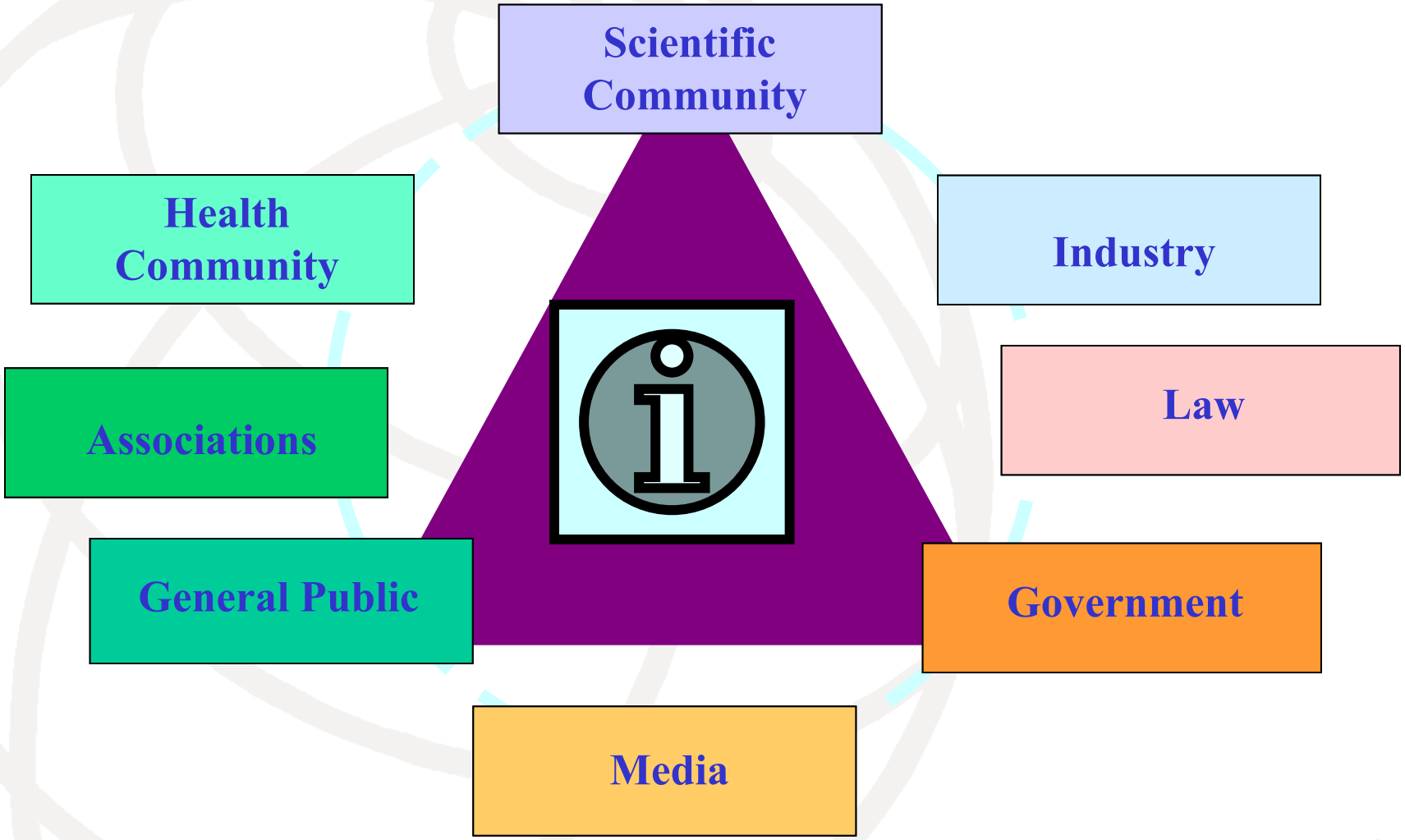
What to Communicate?



- Communicating the science
- Putting the EMF risk in perspective
- Explaining policy measures

Stakeholders

With whom to communicate?



WHO and STANDARDS

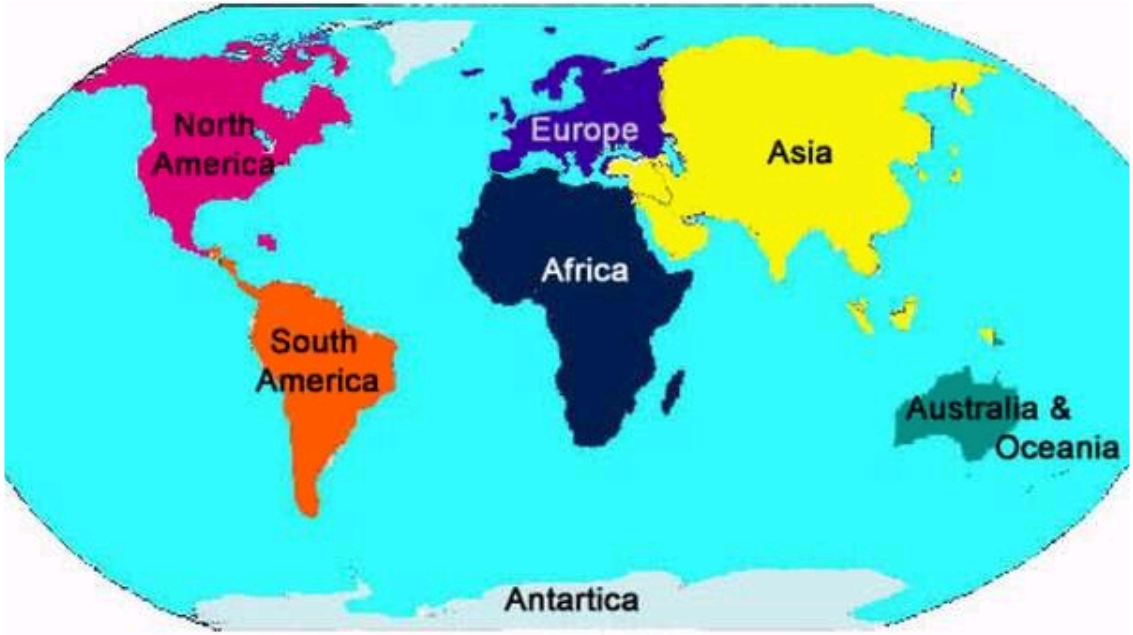
- WHO does NOT develop EMF standards but facilitates international consensus on standards

- International bodies, ICNIRP and IEEE/ICES, develop international guidelines for human protection from EMF exposure

International EMF Project

EMF

EMF WORLD WIDE STANDARDS

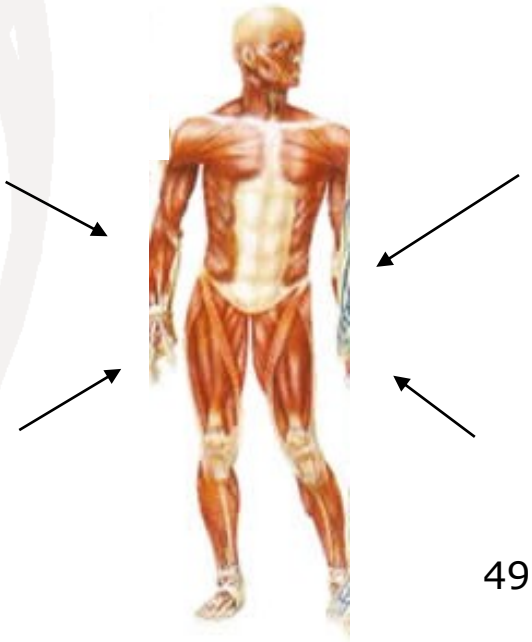


Compiled by Dr Dina Simunic

Norms, Standards and Guidelines

- **Emission standards** have specifications that limit the EMF emissions from devices

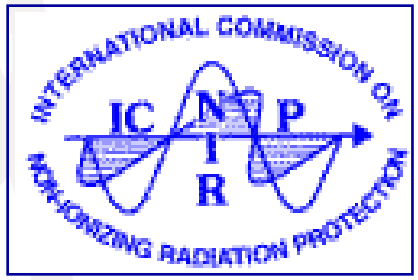
- **Exposure standards** have specifications that limit EMF exposure to people



Relevant Authorities

Non-governmental and international organizations

- **Emission standards**
- **Measurements standards**
- **Exposure standards**

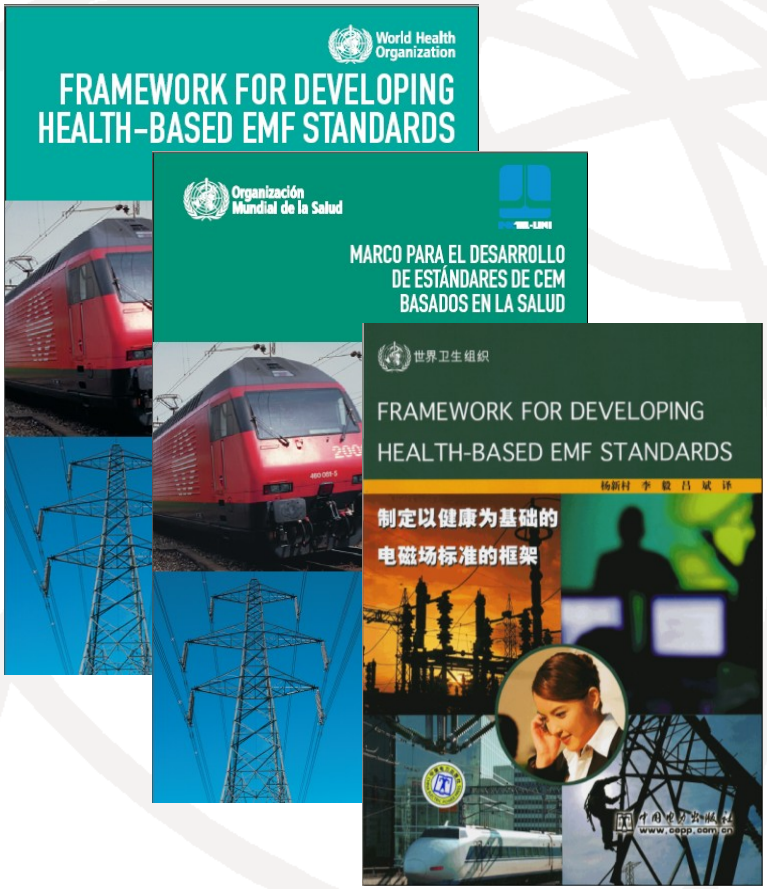


Relevant Authorities

National bodies

Ministry of Health
Ministry of Labour
Ministry of the Environment
Ministry of Transport
Ministry of Energy
Ministry of Telecommunications
….

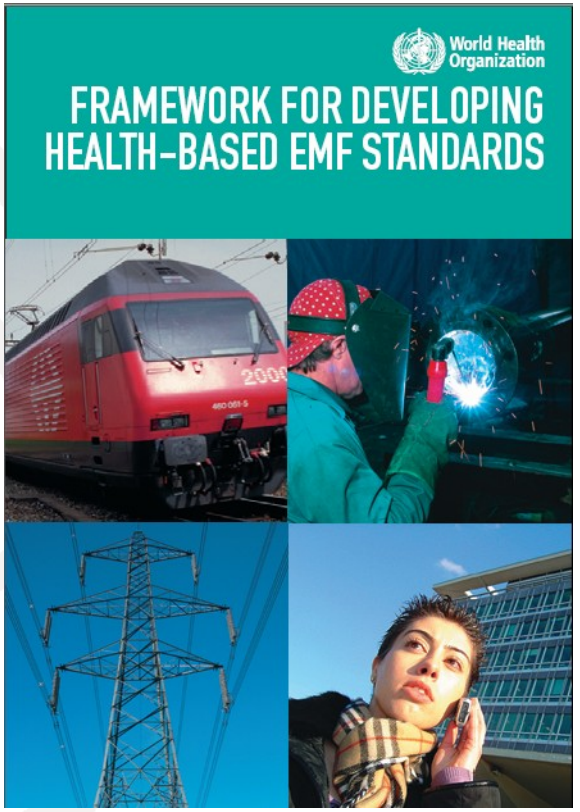
Policy documents ....



http://www.who.int/peh-emf/standards/

Framework for Developing EMF Standards
Motivation

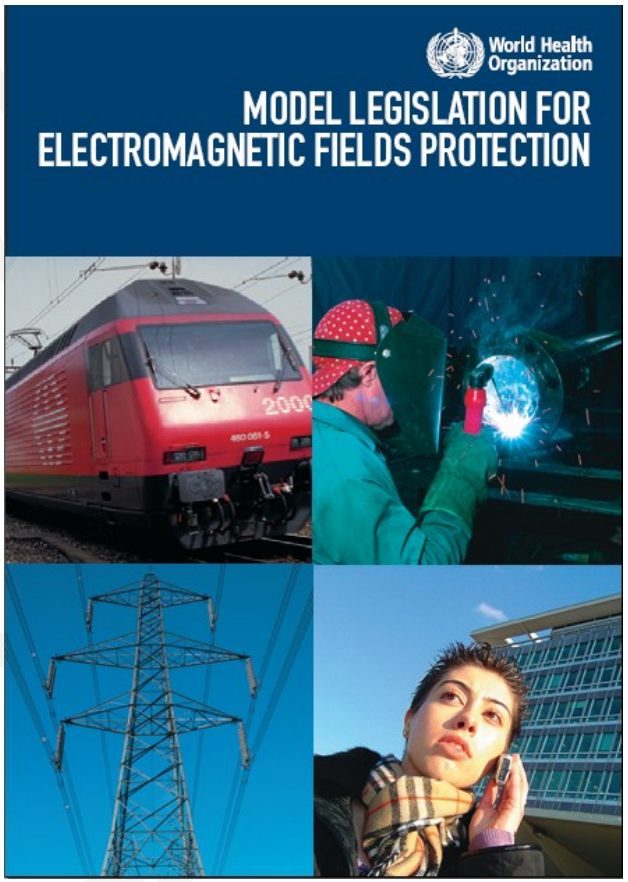
- Concerns about public safety because of increasing EMF exposures from new technologies
- Many countries currently considering EMF standards
- Large differences between national standards



http://www.who.int/peh-emf/standards/framework/en/index.html

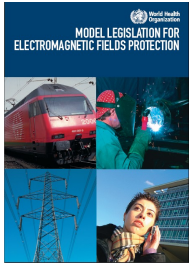
Model Legislation

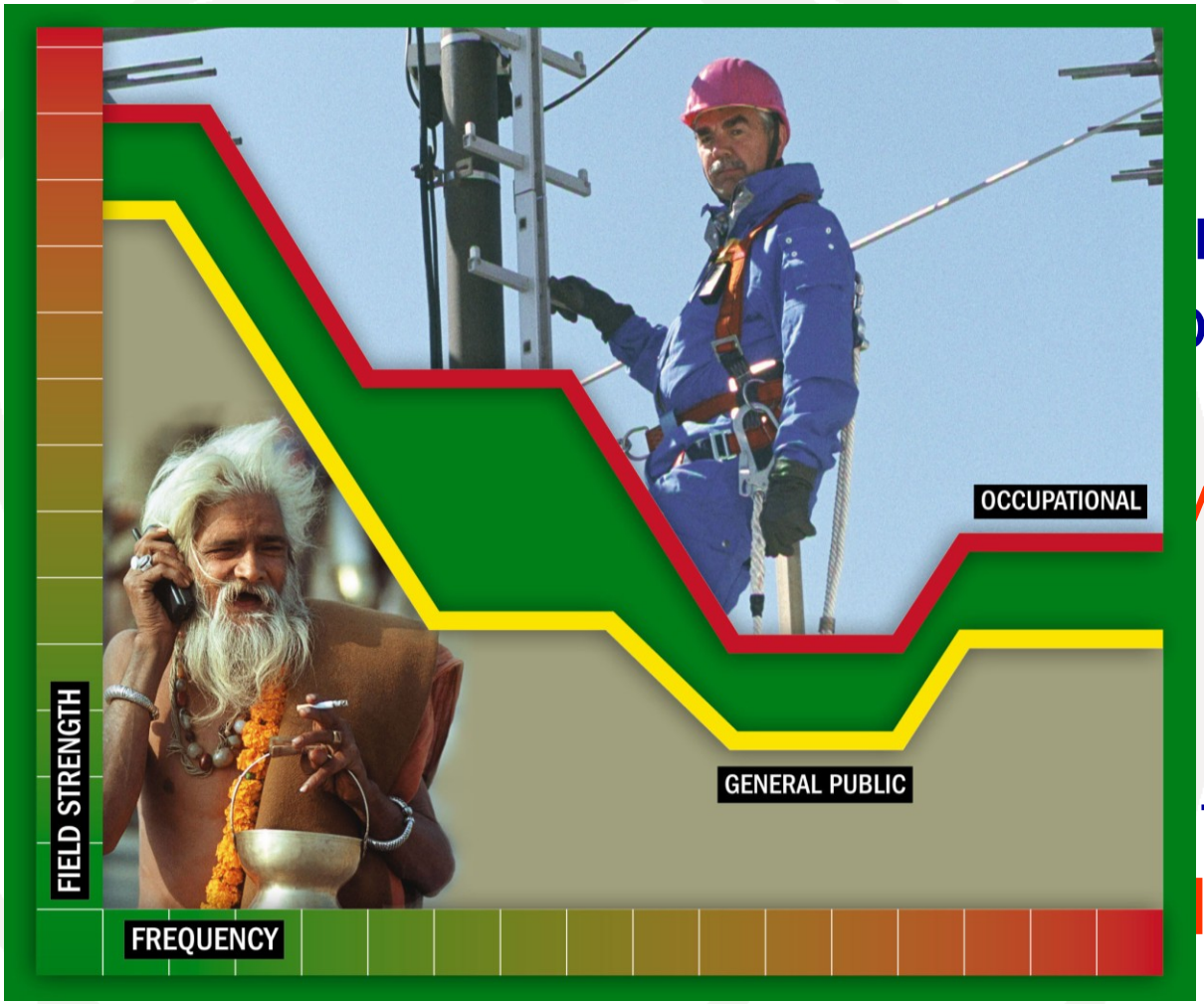
- To assist countries without appropriate legislation to protect their population from EMF
- Provides a legal framework to provide protection from EMF



http://www.who.int/peh-emf/standards/emf_model/en/index.html

Model Legislation





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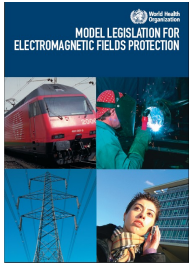
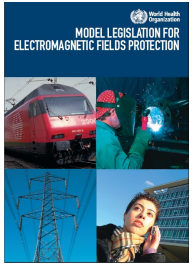
Model Legislation



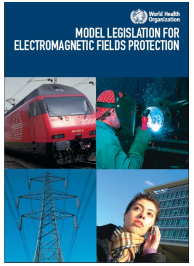
- Purpose
  - to establish limits on human exposure to EMF that will provide protection against known adverse health effects from any installation or device emitting such fields
- Scope
  - Minimum requirements for the protection of the public and workers
  - EMF frequency range 0 to 300 GHz

Model Legislation



- **EMF limits:**
  - Adoption of international standards to limit
    - EMF exposure of people (ICNIRP guidelines)
    - emissions of EMF from devices (IEC and IEEE device emission standards)
  - Uniform application of the Act across the national jurisdiction

Model Legislation (cont'd)



- Compliance
  - Range of options that the Minister may consider appropriate
  - Establish or nominate an agency to administer compliance
- Enforcement
  - Owner of installation to ensure compliance in public places and to provide training to workers (else general public status)
- Record keeping
  - Maintenance of records of exposure measurements
  - Information provision as appropriate

OUTLINE

- Introduction
- Assessing the health risk
- Managing the potential risk
- **Conclusions**

Challenges to governments….

- Rapidly evolving RF technologies
- Launched on the market before health evaluation
- Disparities in risk management measures and regulations around the world
- Concern from the public

Conclusions

- Need for clear roles and responsibilities in government on this topic
- Need for adoption and compliance of health-based standards
- Need for a public information program and dialogue with stakeholders
- Need for promoting research to reduce uncertainty

We are a "global village"

The International EMF Project
Radiation and Environmental Health
Public Health and Environment
World Health Organization
21 Avenue Appia
CH-1211 Geneva 27
Switzerland

email: emfproject@who.int
website: www.who.int/emf