

PROTECTION AGAINST RADIOFREQUENCY EMF: THE CASE OF MOBILE TELEPHONY

Paolo Vecchia
Chairman of ICNIRP

Seminario ITU - Buenos Aires, Argentina, 16-17 December 2010

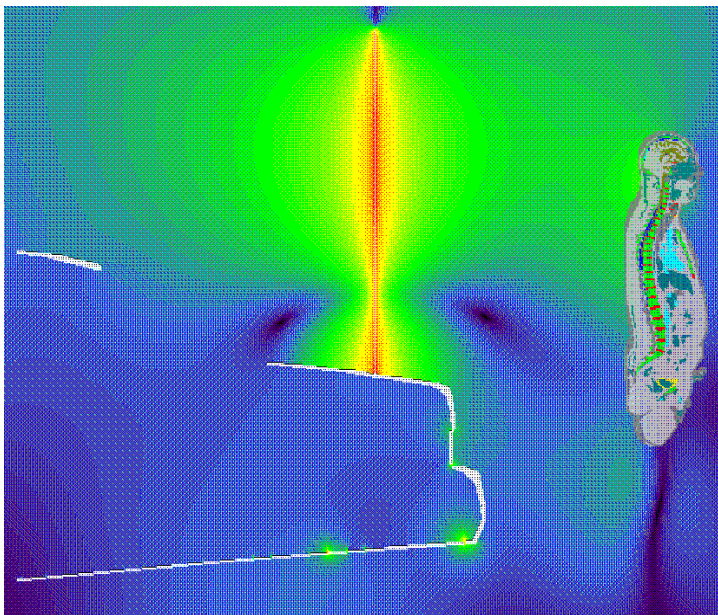


THERMAL EFFECTS?

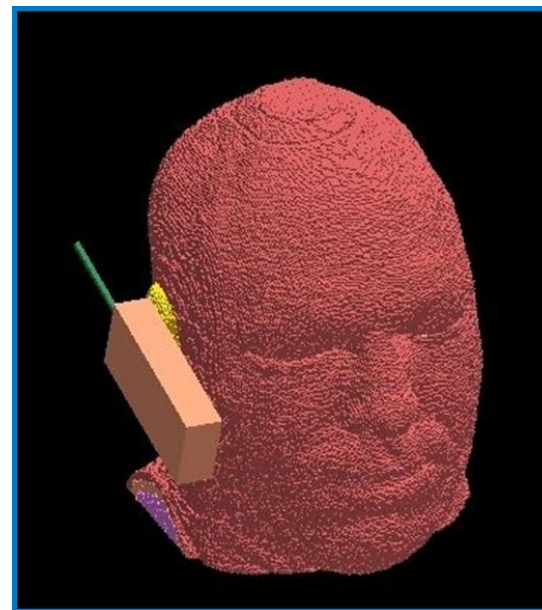
The possibility of thermal effects due to the close proximity of the antenna to the head has been the **first concern** of scientists, triggering wide and sophisticated research.

NUMERICAL MODELS

Fixed antennas
(Radio Base Stations)



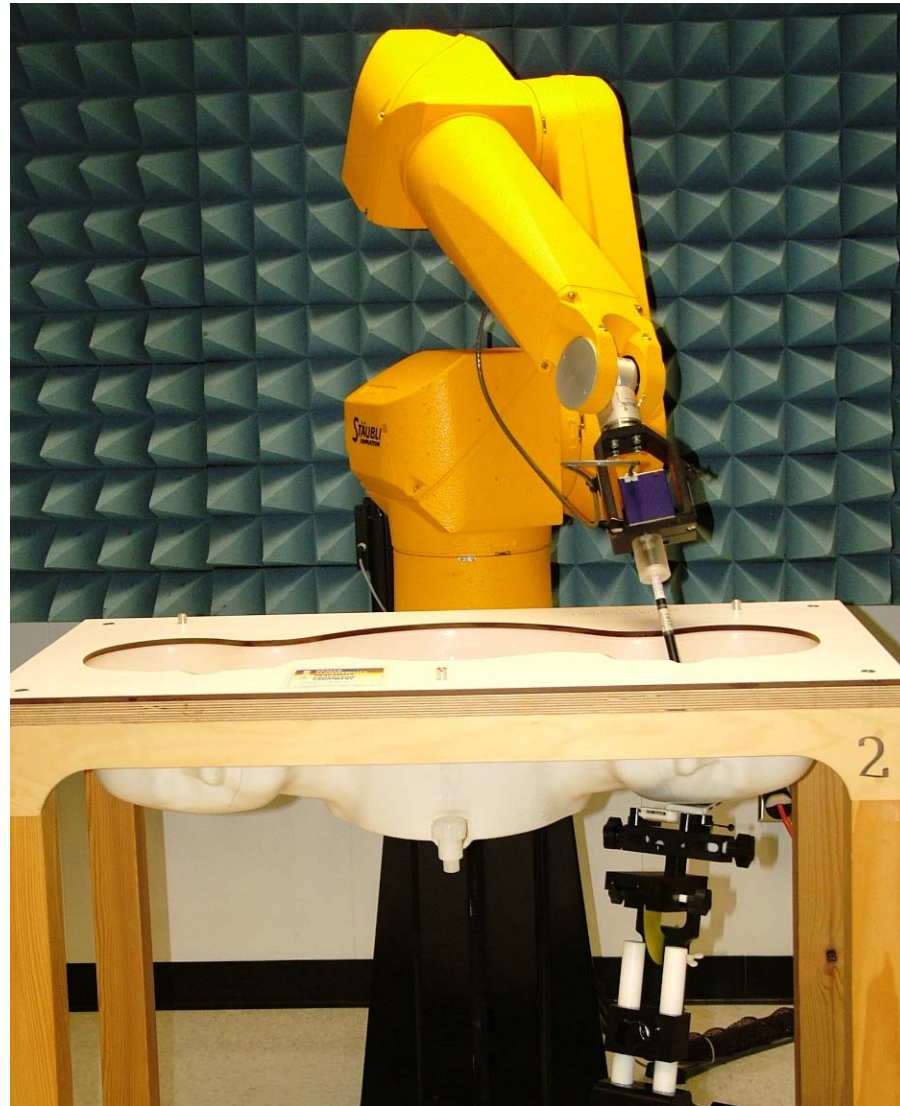
Mobile phones



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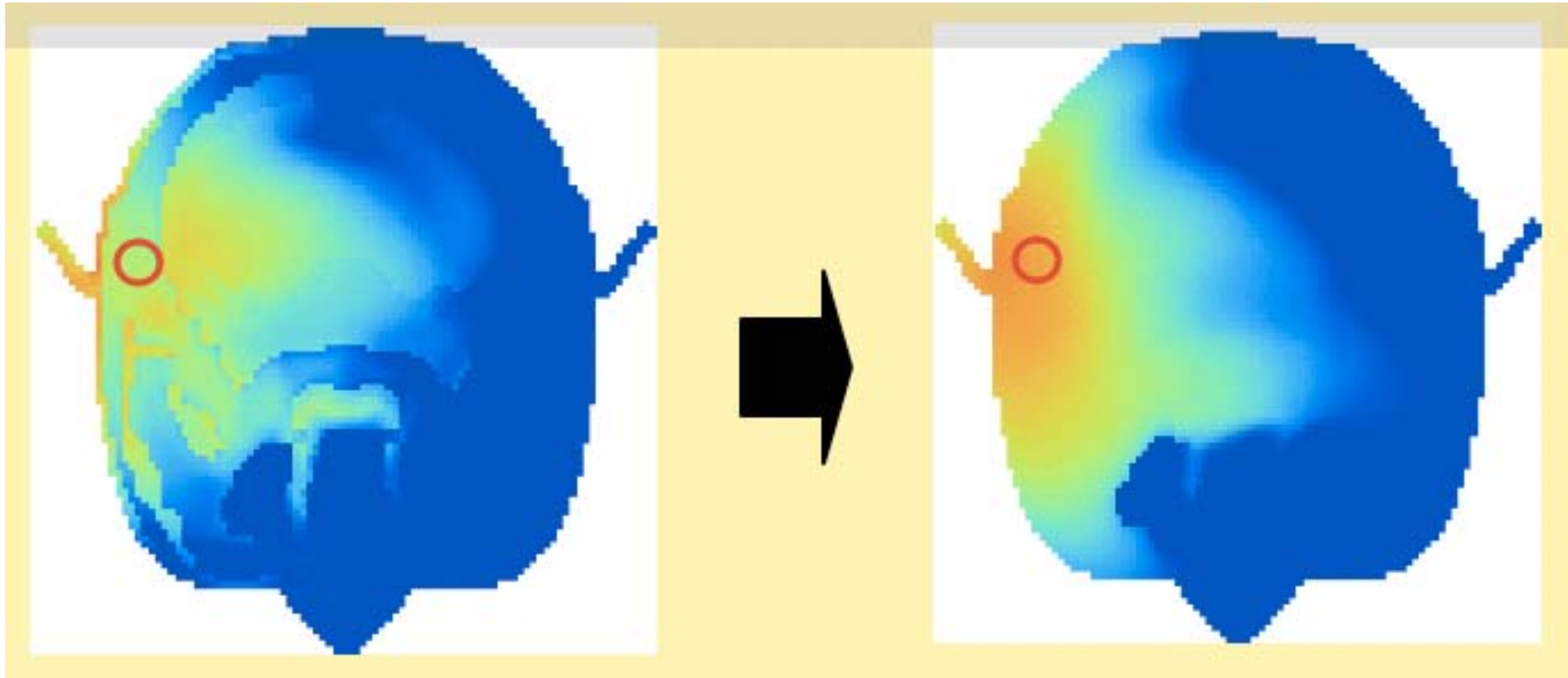
EXPERIMENTAL TESTS



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EVALUATION OF THERMAL EFFECTS



Energy Absorption (SAR)

Temperature

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CONCLUSIONS ON THERMAL EFFECTS

The increase of temperature at the outer ear is of the order of 0.1-0.2 °C.

Such increase is well below the basis for the international limits (1 °C)

It is also lower than normal physiological changes (e.g. due to physical activity) and is easily compensated by thermoregulation.

“THERMAL” EFFECTS OF MOBILE PHONES

Vladimir Lagovski and Andrei Moiseynko from Komsomolskaya Pravda Newspaper in Moscow decided to learn first-hand how harmful cell phones are. There is no magic in cooking with your cell phone. The secret is in the radio waves that the cell phone radiates.

The journalists created a simple microwave structure as shown in the picture. They called from one cell phone to the other and left both phones on talking mode. They placed a tape recorder next to phones to imitate sounds of speaking so the phones would stay on.



After, 15 minutes: The egg became slightly warm.

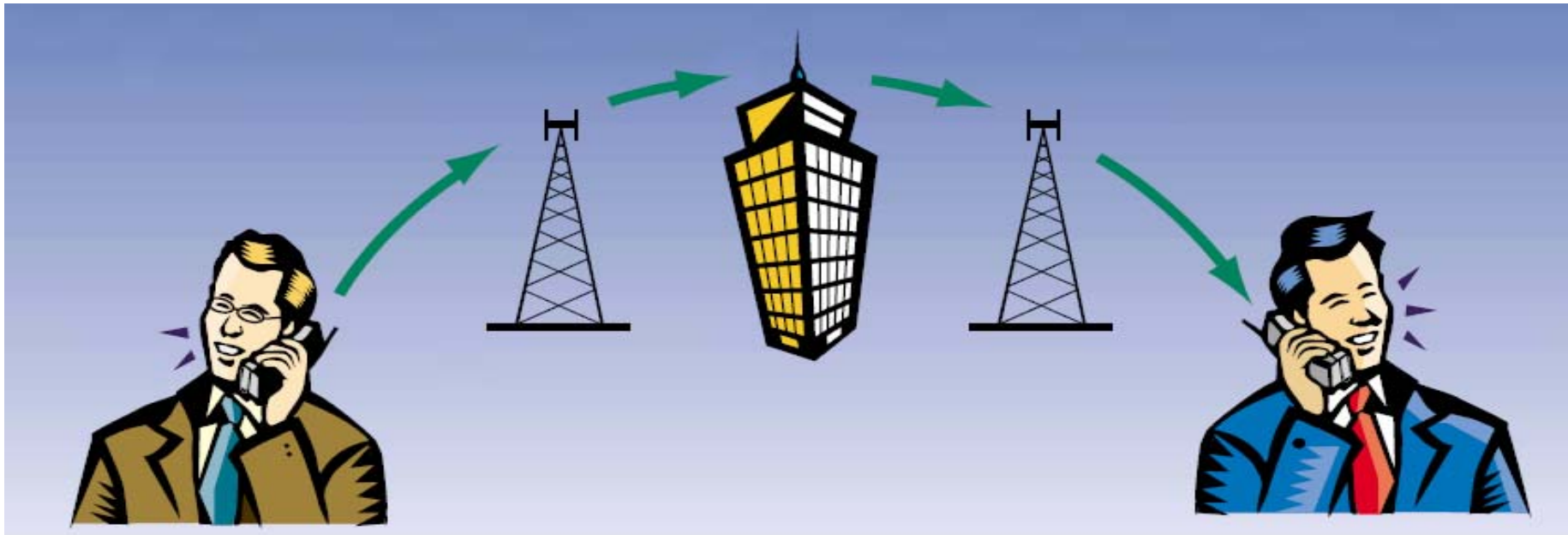
25 minutes: The egg became very warm.

40 minutes: The egg became very hot.

65 minutes: The egg was cooked. (As you can see.)



HOW DOES MOBILE TELEPHONY WORK?



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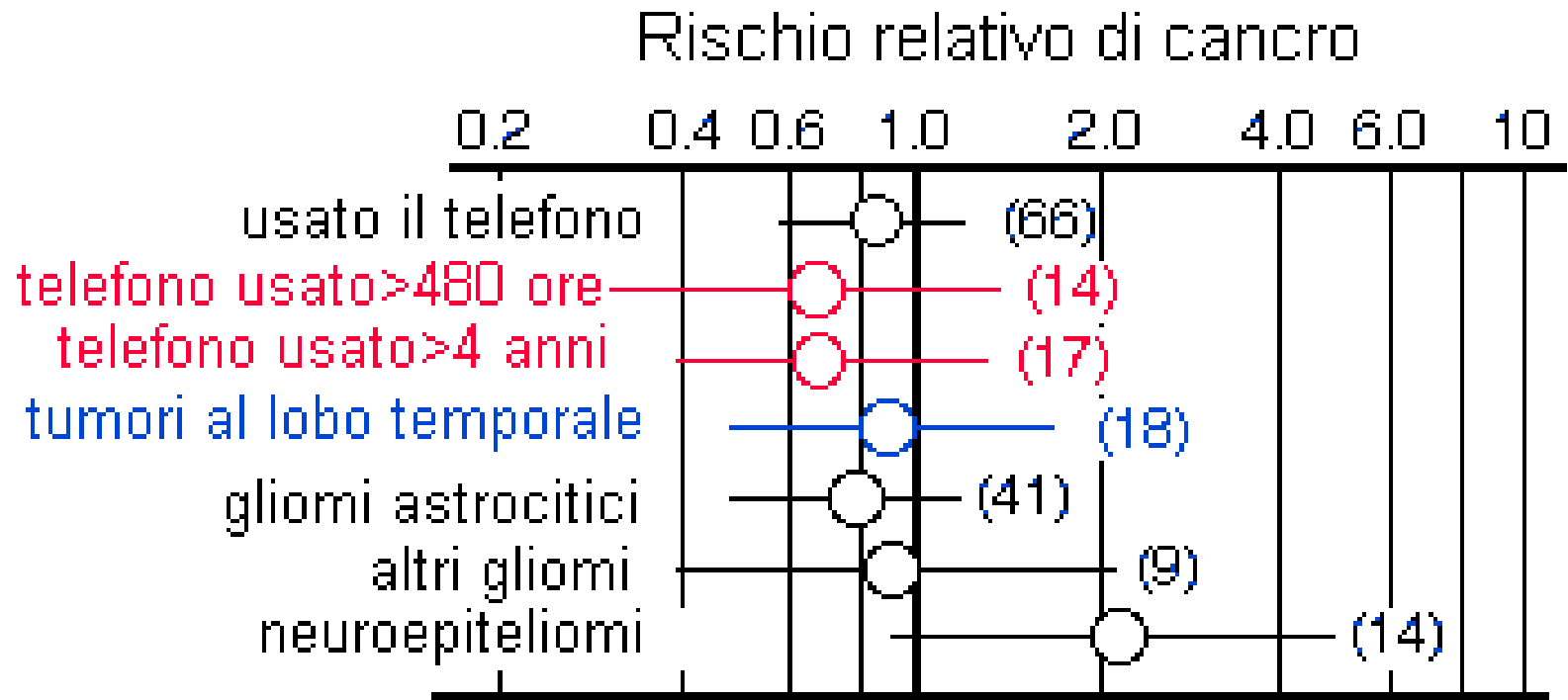


NON-THERMAL EFFECTS

With regard to non-thermal interactions, it is in principle impossible to disprove their possible existence but the plausibility of the various non-thermal mechanisms that have been proposed is very low.

In addition, the recent *in vitro* and animal genotoxicity and carcinogenicity studies are rather consistent overall and indicate that such effects are unlikely at low levels of exposure.

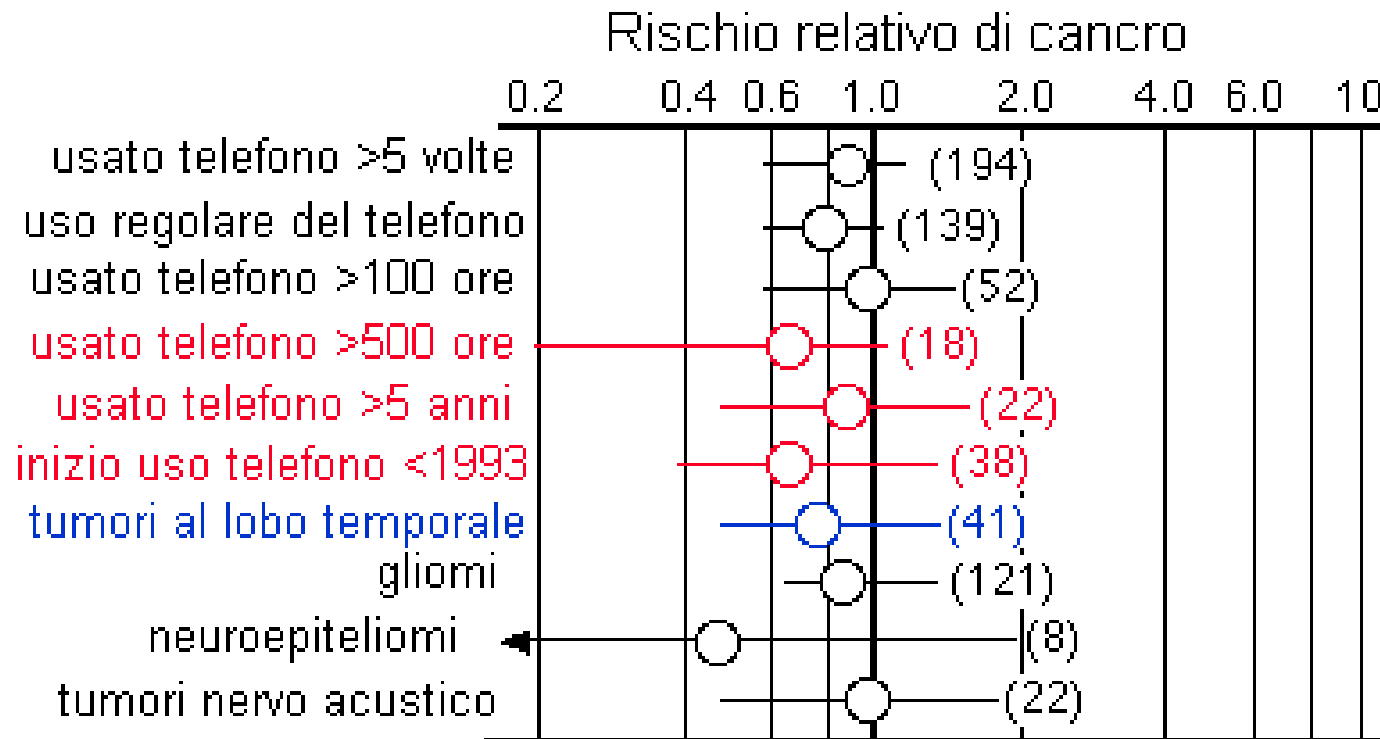
MUSCAT ET AL (2001)



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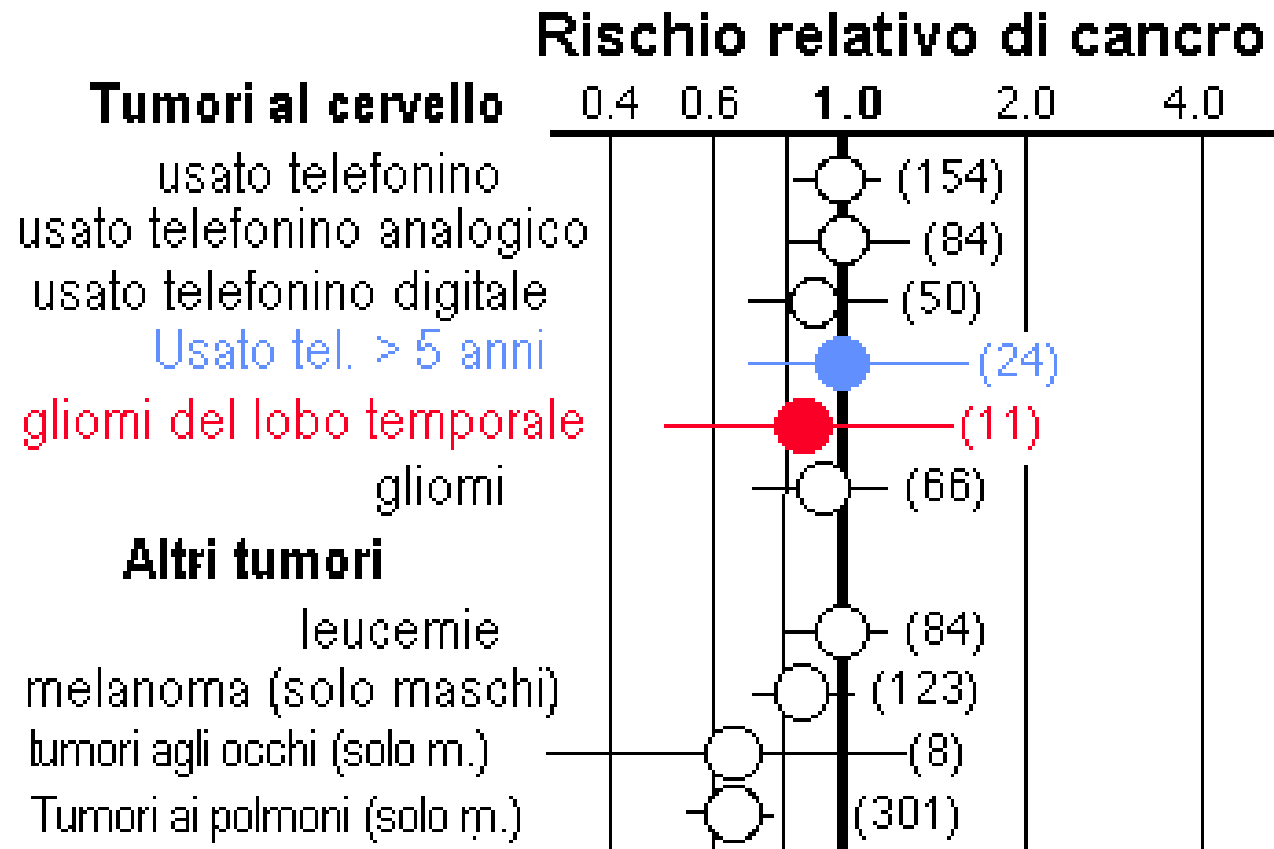


INSKIP ET AL (2001)



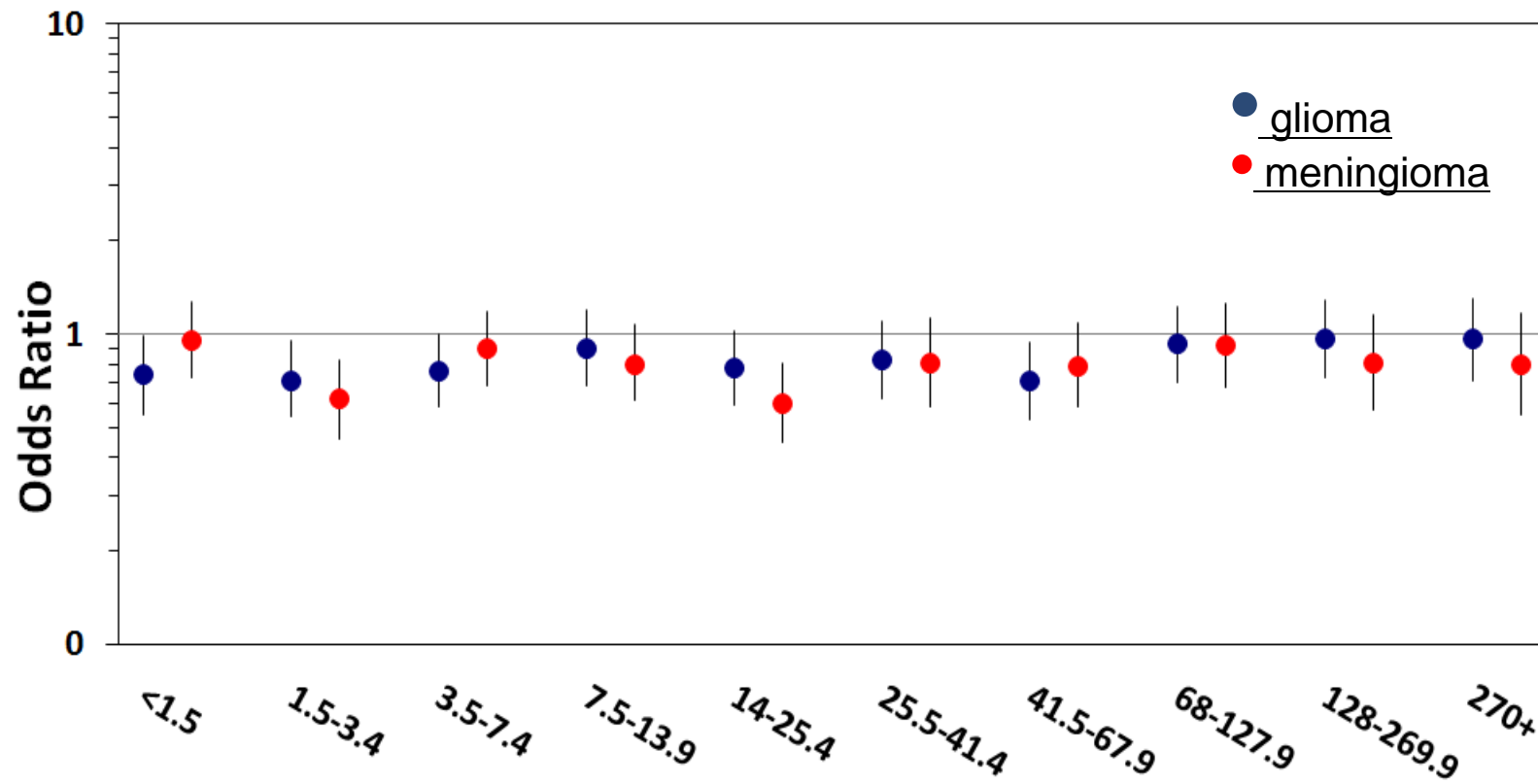
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JOHANSEN ET AL (2001)



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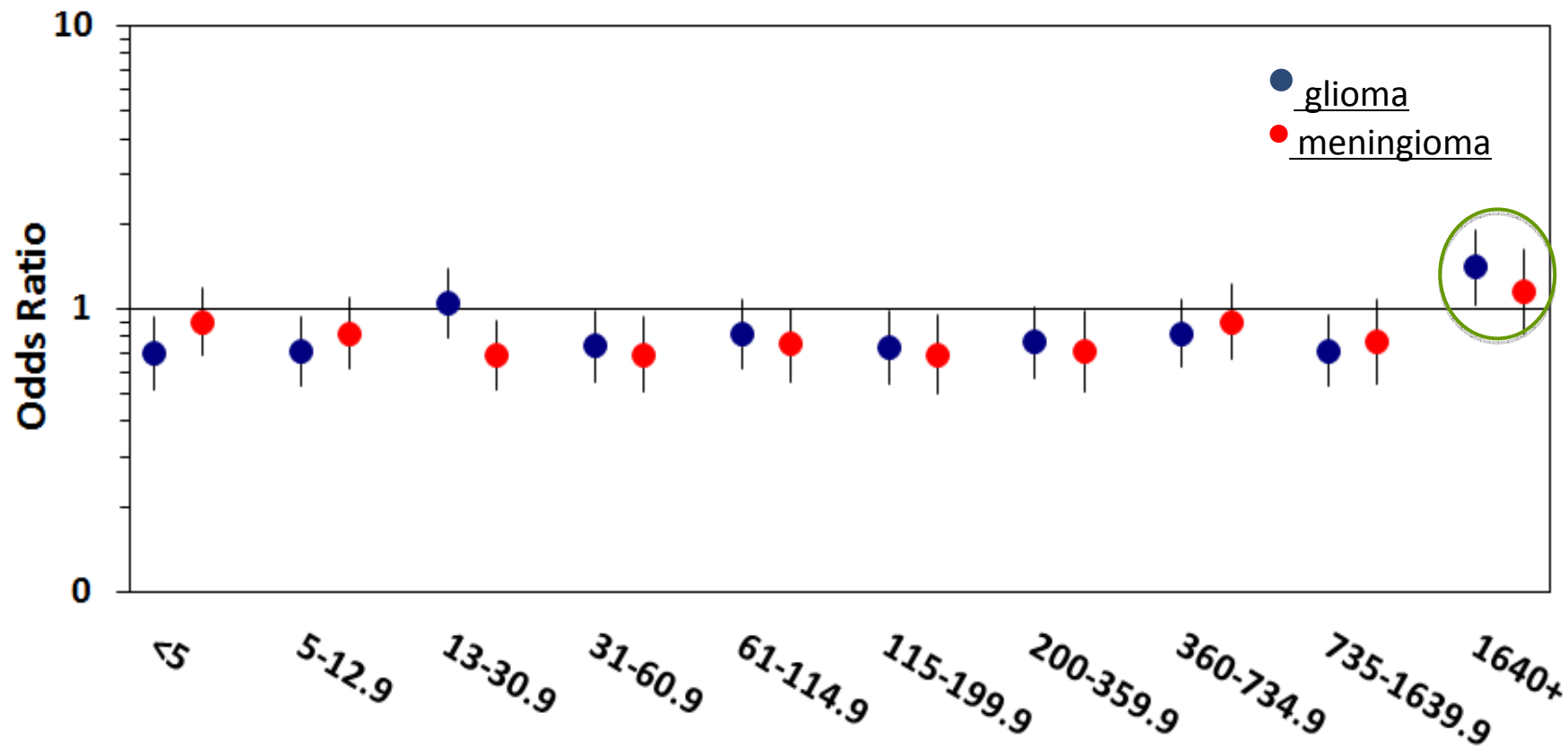
TOTAL NUMBER OF CALLS (X 100)



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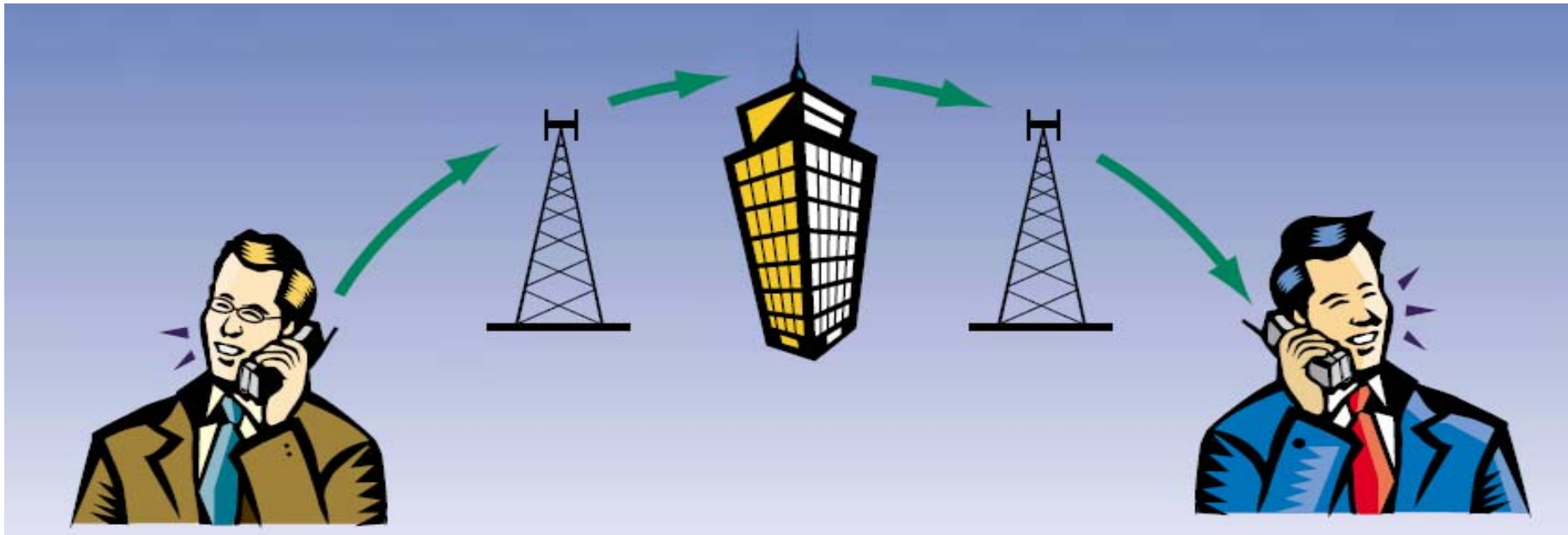
CUMULATIVE TIME OF USE (HOURS)



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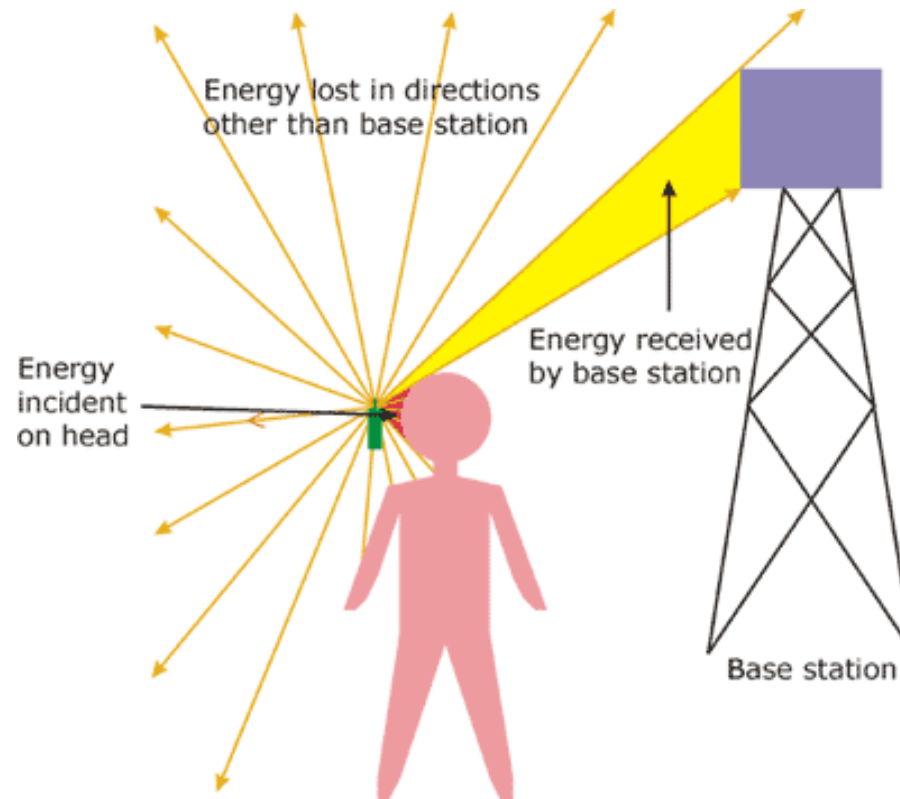
HOW DOES MOBILE TELEPHONY WORK?



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BI-DIRECTIONAL EXCHANGE OF ENERGY



Which are the proportions?

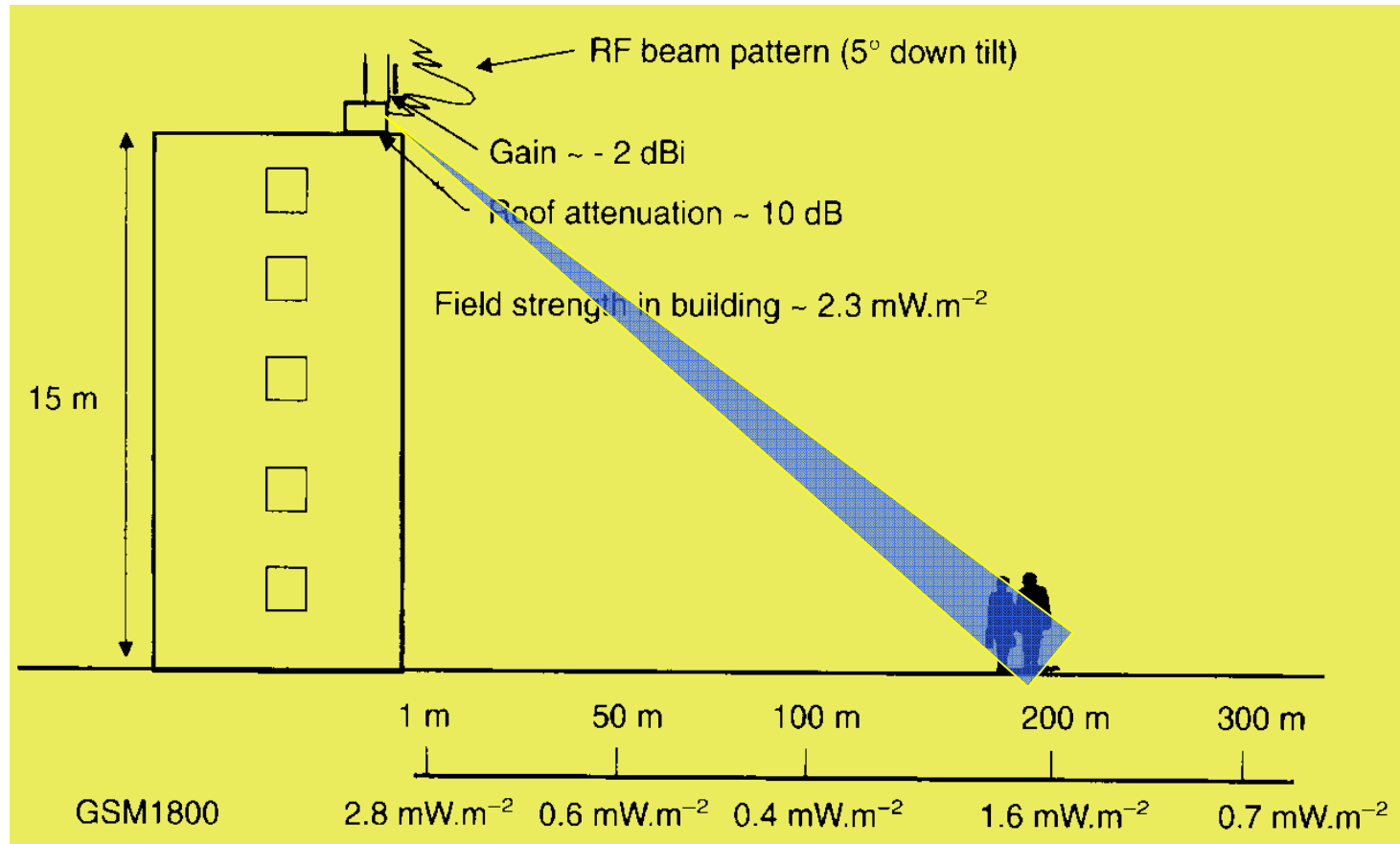
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BASE STATIONS vs HANDSETS

Local SAR due to exposure to the handset during a call is orders of magnitude (typically 100 to 1000 times) lower than SAR from exposure to base stations in realistic conditions.

EXPOSURE CLOSE TO A RBS



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NEW ZEALAND

- The National Radiation Laboratory has measured exposures around many operating cellsites.
- Maximum exposures in publicly accessible areas around the great majority of sites are **less than 1% of the public exposure limit** in the Standard.
- Exposures are rarely more than a few percent of the limit, and **none have been above 10%**.

COMMON APPROACH OF NORDIC AUTHORITIES

The exposure to the general public from base stations is extremely low, normally 100 to 10 000 times lower than the ICNIRP guidelines and very much lower than the exposure from the handsets.

THE NETHERLANDS

The Committee considers the **likelihood of health problems** arising in work and residential areas near GSM 900 and DCS 1800 base stations due to exposure to electromagnetic fields originating from the antennas, **extremely small**.

The **field strengths are always considerably lower than the health-based exposure limits** proposed by the Health Council and other organizations.

GSM Base Stations, June 2000

FRANCE

Overall, there is **no evidence**, at the date, of **increase in cancer** incidence around high-power emitters and, a fortiori, around base stations

French Senate, 2001

SPAIN

In accordance with previous conclusions, this Board considers that, at current emission strengths, at the distances calculated according to criteria of the EU Recommendation and on the basis of current available scientific evidence, **cell phone antennas do not represent a public health hazard.**

Electromagnetic Fields and Public Health

AUSTRALIA

No adverse health effects are expected from continuous exposure to radiofrequency radiation emitted by the antennas on mobile telephone base station towers

Mobile Telephone Communication Antennas: Are They a Health hazard? Fact Sheet No. 4

NEW ZEALAND

- Is it safe to live near a cellsite?
- Yes. Measurements carried out by NRL around several dozen cellsites have shown that maximum exposures are typically about 1 or 2% of the exposure limit recommended in New Zealand and international exposure standards. In most areas they are less than that. No health effects are anticipated at such low exposures.
- www.nrl.moh.govt.nz/faq.html

SWEDEN

To summarize, mobile telecommunications base stations
do not constitute a risk regarding radiation protection.

*Radiation from Mobile Telecommunications Base Stations,
SSI, 2001*

WHERE IS THIS ANTENNA?



In Stockholm

Inside the
Karolinska Hospital

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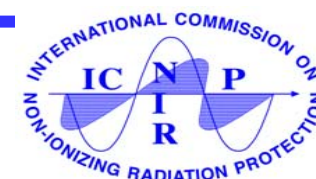


AND THIS ANTENNA?

In Geneva

Over the
WHO Headquarters
Building

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CAUTIONARY MEASURES?

There has been a strong social pressure for the adoption of precautionary measures.

While several protection agencies have suggested simple, low-cost actions to be adopted by individuals to reduce personal exposure, some governments and local authorities have adopted limits different from international recommendations.

Other precautionary measures include minimum number of base stations, relocation outside inhabited areas, etc.

SCIENCE AND CAUTIONARY MEASURES

A **principle requirement** is that such policies be adopted only under the condition that **scientific assessments** of risk and science-based exposure limits should not be **undermined by** the adoption of **arbitrary cautionary approaches**. That would occur, for example, if limit values were lowered to levels that bear no relationship to the established hazards or have **inappropriate arbitrary adjustments** to the limit values to account for the extent of scientific uncertainty.

WHO 2000

MOTIVATION FOR CAUTIONARY MEASURES

Are precautionary measures adopted in some countries at either national or local level motivated by

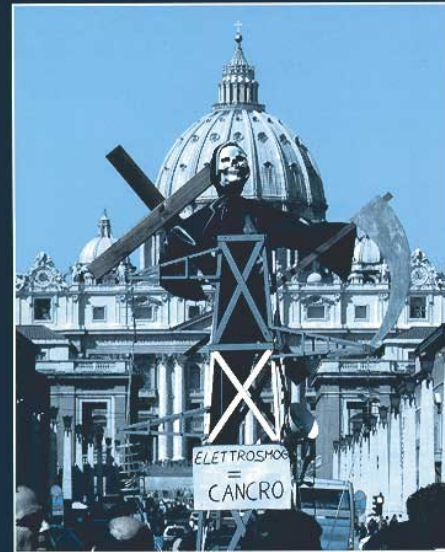
- Adverse effects on health?

or

- Public anxiety and protest?

**A HEALTH PROBLEM
OR
A SOCIAL PROBLEM?**

**CELLULAR PHONES,
PUBLIC FEARS,
AND A CULTURE
OF PRECAUTION**



ADAM BURGESS

CAMBRIDGE

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Public health impact and public perception of selected environmental health risks in Italy

Exposure	Disease	Expected cases/year	Public health relevance	Public perception of risk
Radon	Lung cancer*	2.200-5.100 ⁽¹⁾	+++	+
Benzene	Leukaemia**	16-275 ⁽²⁾	++	++
EMF	Leukaemia**	3 ⁽³⁾	+	+++

* Estimated total lung cancer cases per year @ 32.000

** Estimated total leukaemia cases per year @ 5.000

(1) Estimates based on published literature

(2) Italian National Toxicological Committee estimates

(3) WHO, 1997



WHO European Centre for Environment and Health, Rome Division

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WHO RECOMMENDATIONS

- **Public protection against EMF**
- *Recommendations to Member States*



Facing Health issues

- Compulsory standards
- Science-based measures

Facing public concern

- Separate voluntary standards
- Precautionary measures

EFFECTIVENESS OF MEASUREMENTS

Any measure adopted, including precautionary measures, must be effective for its specific purpose.

- Measures aimed at reducing health risks must be evaluated based on the health benefit
- Measures aimed setting down public concern must be evaluated based on the reduction of controversies

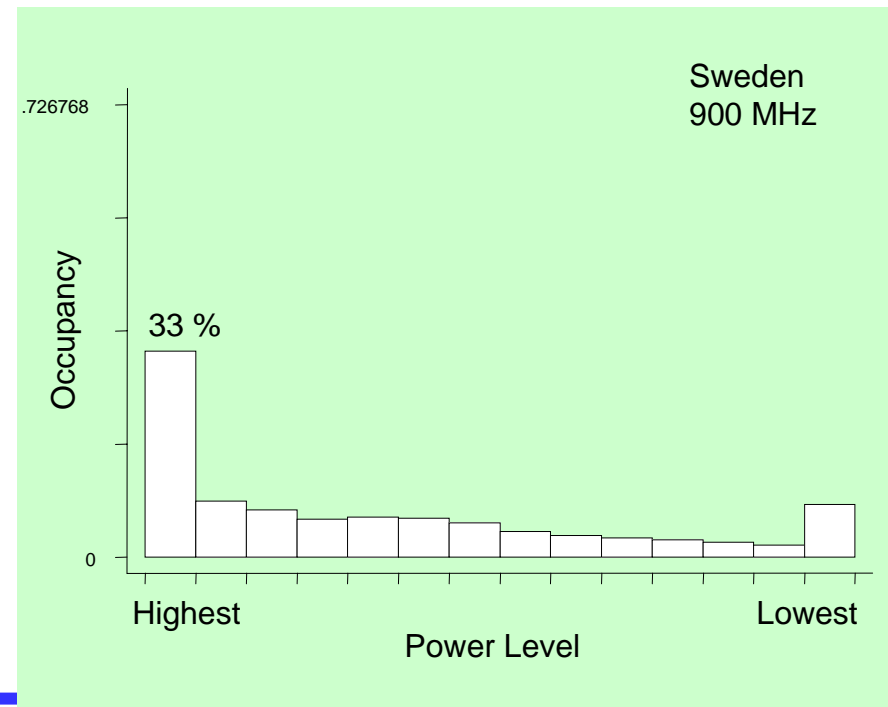
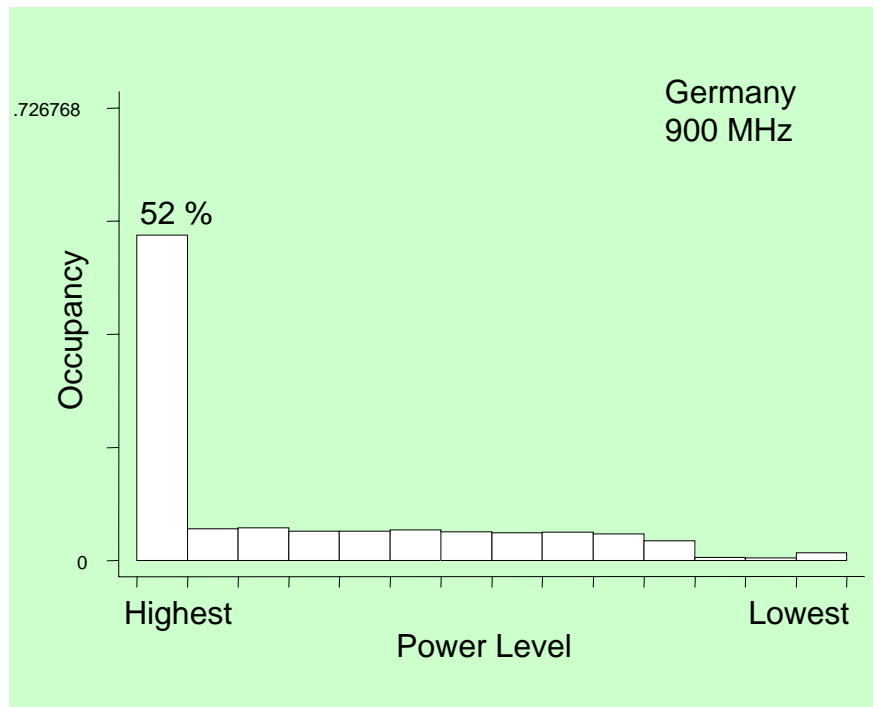
REDUCTION OF EXPOSURE?

- The exposure from mobile phone is much more important than exposure to base stations
- Power emitted by mobile phones is controlled by the adaptive power control (APC)
- An increased distance from the base station results in little or no reduction of the environmental level of electromagnetic fields and in a significant increase of power emitted by the phones

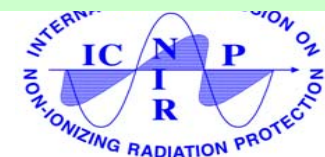
EFFECTIVENESS OF CAUTIONARY MEASURES THE CASE OF BASE STATIONS

Locating base stations far away from high-traffic areas or reducing their number may **greatly increase** users' exposure, due to the high power necessary for distant communication and the high rate of handovers, respectively

DISTRIBUTION OF POWER LEVELS FROM MOBILE PHONES



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AVERAGE OUTPUT POWER OF MOBILE PHONES

Location	Average power at 900 MHz	Average power at 1800 MHz	% of samples per call made at max power	% of calls made entirely at max power
Australia	134.8	64.8	35.3	14.7
Denmark	160.5	64.1	36.8	18.3
Finland	167.8	88.3	60.3	32.1
France	152.4	81.5	52.0	25.3
Germany	155.7	79.1	54.4	38.5
Israel	92.3	47.2	23.7	10.1
Italy	162.8	74.9	45.7	26.7
New Zealand	170.6	69.2	54.2	39.0
Sweden	118.2	51.1	31.6	17.2
UK North 1	118.3	74.7	45.6	26.3
UK North 2	157.8	73.9	50.5	32.9
Total	132.4	64.5	39.4	21.3

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PRECAUTIONARY LIMITS AND WORRIES

- Adoption of very restrictive and arbitrary EMF exposure limits by countries tends to increase public concern rather than reducing worries and controversies.
- Difference between limits tends to create confusion and mistrust of authorities.
- Choosing exposure limits that cannot be justified, either scientifically or logically, have already created some mistrust of the science, and in the authorities.
- *Cognetti Commission (Italy), 2002*

THE VICIOUS CIRCLE



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THE FRENCH EXPERIENCE

The group of experts recommend that 'sensitive' buildings (hospitals, day care centers, and schools), located less than 100 metres from a base station, should not be directly in the path of the transmission beam.

Zmirou Report, 2001

EXPECTED EFFECTS ON RISK PERCEPTION

The group of experts feel that, if operators apply these measures, **public fears**, especially those of parents concerned by their children's exposure in school, **will be allayed**, especially keeping in mind that, in view of the exposure levels observed, the group of **experts does not back the hypothesis** that there is a health risk for populations living in the vicinity of base stations.

Zmirou Report, 2001

OBSERVED EFFECTS ON RISK PERCEPTION

The recommendation of the 2001 Report, aiming at reassuring, resulted in the opposite effect.

Therefore, the expert group does not maintain the need for this concept of “sensitive site” for base stations.

Such conclusion specially applies to schools, where the risk perception is the highest.

AFSSE 2003

REDUCTION OF WORRIES?

Journal of Risk Research
Vol. 9, No. 4, 361-372, June 2006



ARTICLE

The Impacts of Precautionary Measures and the Disclosure of Scientific Uncertainty on EMF Risk Perception and Trust

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ABSTRACT This study evaluates the impact on risk perception and trust in public health protection resulting from disclosure of information about implementation of precautionary measures and from the disclosure of scientific uncertainty in the area of mobile telephony. Based on an experimental design, the study supports our recent findings (Wiedemann and Schütz, 2005) that precautionary measures may trigger concerns and amplify EMF-related risk perceptions. Furthermore, our present data once again indicates that information about the implementation of precautionary measures has no positive effect on trust in public health protection. These results, contrary to common expectations, should be considered in decisions about precautionary measures. Risk managers who intend to implement precautionary measures merely as a means for reassuring the public will probably fail. Indeed, even if precautionary measures are justified from a public health perspective, it seems prudent to anticipate the possibly countervailing effects of such measures on the public. This leads to two important challenges for risk communication, first to clarify the difference between hazard and risk and, second, to help avoid such unwanted effects by designing better communication about precautionary measures.

KEY WORDS: Precautionary measures, scientific uncertainty, risk management, risk perception, trust

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Research Article

The Precautionary Principle and Risk Perception: Experimental Studies in the EMF Area

Peter M. Wiedemann and Holger Schütz

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Possible adverse health effects due to electromagnetic fields (EMFs) from cellular phones and base stations present a major public health issue across Europe. Because scientists cannot exclude that EMFs may cause health problems, the application of the precautionary principle is debated heavily. By considering precautionary measures, political decision makers hope to cope with public fears about EMFs. We present results from two experimental studies that indicate that precautionary measures may trigger concerns, amplify EMF-related risk perceptions, and lower trust in public health protection. Such impacts, questioning common expectations, should be considered in decisions about precautionary measures. **Key words:** base stations, electromagnetic fields, health protection, mobile phones, precautionary principle, risk perception. *Environ Health Perspect* 113:402-405 (2005). doi:10.1289/ehp.7538 available via <http://dx.doi.org/> [Online 10 January 2005]

The public debate about possible adverse health effects from exposure to electromagnetic fields (EMFs) from cellular phones and base stations is one of the risk issues that occupies many political decision makers across Europe (Burgess 2004). Because scientists cannot exclude the possibility that EMFs may cause health problems (Independent Expert Group on Mobile Phones (IEGMP) 2000; National Radiological Protection Board (NRPB) 2003; Strahlenschutzkommission (SSK) 2001), the application of the precautionary principle is heatedly discussed in many countries. For instance, the IEGMP indicated that the balance of evidence showed no adverse health effects from exposure to radio frequency radiation from mobile phone technologies. However, the group still recommended that "a precautionary approach to the use of mobile phone technologies be adopted until much more detailed and scientifically robust information on any health effects becomes available" (IEGMP 2000, p. 3).

Essentially, the precautionary principle recommends that action should be taken to prevent serious potential harm, regardless of scientific uncertainty as to the likelihood, magnitude, or cause of that harm. By considering precautionary measures, political decision makers hope to cope with these public fears about EMFs. Various courses of action are taken into consideration, including health-related measures such as exposure minimization strategies or stricter exposure limits, process-related measures such as better risk communication and enhancing public participation in base station siting decisions, and research-related measures (Wiedemann et al. 2001). In various countries, different options have been chosen, such as participatory site selection of base stations in the Netherlands, stricter exposure limits in Switzerland, and better risk communication in the United Kingdom (public access to databases revealing

the sites and technical features of the base stations), as well as labeling of cellular phones (discussed also in Germany) and general exposure reduction measures, just to name a few (Bundesamt für Strahlenschutz (BfS) 2004; NRPB 2005; TCO 2001).

Although the theoretical status and rationality of the precautionary principle have been discussed in many papers (Commission of the European Communities 2000; Foster et al. 2000; Kriebel et al. 2001; Marchant 2003) and conferences (Grandjean et al. 2003; Raffensberger and Tickner 1999; World Health Organization (WHO) 2003), only a few empirical studies analyze the impact of precautionary measures on risk-related attitudes and beliefs.

Risk Perceptions as Triggers for Precautionary Action

Whether public risk perception should be a stimulus for invoking precautionary measures in risk management is a sensitive question (Goldstein and Carruth 2004). Opponents to this approach stress the point that risk management should be based on sound science using the best available scientific evidence. They assume that perceived risk differs from assessed risk in that it may more readily be manipulated. In addition, they fear that precautionary measures may undermine the scientific basis for the established exposure limits. In their view, precautionary measures for EMFs should be adopted only with great care.

Proponents argue that public risk perception should be taken into account in decisions about risk management. When the public is concerned about a risk, risk managers should address these concerns by invoking additional protective measures. Furthermore, they underline that societal values and public willingness to accept a risk are key factors in determining a society's level of protection. Thus, public risk perception must be recognized as a factor in

the decision to apply precautionary measures. That is, in addition to scientific data, knowledge gained from the practical experience of professionals and risk perceptions of lay people are seen as a valid basis for making decisions about when to invoke precautionary measures (e.g., Gee and Stirling 2003; Tickner 2003).

Research Questions

Several studies have investigated the impact of risk communication on risk perception (e.g., MacGregor et al. 1994; Morgan et al. 1985; Purchase and Slovic 1999; Schütz and Wiedemann 1995). However, to date, no one—at least to our knowledge—has addressed empirically the question of whether the communication of precautionary measures influences risk perceptions and, if so, in which direction. This is astonishing, especially because risk perceptions play a prevalent role in the discussion about the necessity of involving the precautionary principle.

In this article we focus on the issue of how people react to the implementation of the precautionary principle. The key is the impact of precautionary measures on risk perceptions. Two opposing hypotheses can be derived from the current available literature. First, precautionary measures will increase trust in risk management, and, in turn, increased trust in risk management will be associated with lower risk perceptions. Second, the alternative hypothesis points to the possibility that precautionary measures will be considered a cue that the risk might be real. Here, perceived risk should be amplified.

As discussed above, the reason for invoking the precautionary principle is scientific uncertainty. Thus, it would be of interest to see whether emphasizing the uncertainty in scientific knowledge about EMF risks will affect risk perception. We conducted two experiments to address these questions. In the first experiment, health-related precautionary

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We thank the students of the Psychology Department of the University of Innsbruck for their support in conducting the experiments, and are also grateful to three anonymous reviewers who commented on a first version of this article.

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WIEDEMANN ET AL. 2005

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THE CRUCIAL QUESTION: SAFE OR DANGEROUS?

- Are radiofrequency electromagnetic fields a health risk?
- Is mobile telephony a health risk?
- Are radio base stations a health risk?

Science can never prove the negative

The proof of total safety does not exist

WHO – INTERNATIONAL EMF PROJECT

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Electromagnetic fields (EMF)

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Electromagnetic fields



Electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed to varying degrees of EMF, and the levels will continue to increase as technology advances.

As part of its Charter to protect public health and in response to public concern, the World Health Organization (WHO) established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz.

The EMF Project is open to broad participation

The EMF Project is open to any WHO Member State government, i.e. department of health, or representatives of other national institutions concerned with radiation protection. The project is fully funded by participating countries and agencies.


Further information

- for more information on the EMF Project, please email: emfproject@who.int

Quick links

- About us
- Publications
- Contact us

Participating countries & entities in EMF Project



WHAT'S NEW!

2010 WHO Research Agenda for Radiofrequency Fields has been published
[Click here for more information](#)

Electromagnetic fields and public health: mobile phones May 2010

QUICK LINKS IN THE EMF SITE

- Model Legislation
- More information

www.who.int/emf

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FACT SHEETS

International
EMF Project



Български	Deutsche	English	Español
Français	עברית	Italiano	
Nederlands	Русский	Svenska	Chinese
Arabic	Slovensko	ελληνικά	

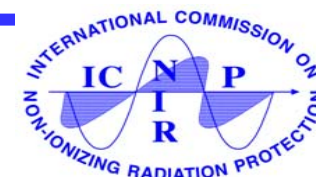
Fact Sheets and Backgrounders

- ▶ [Electromagnetic Fields and Public Health: The International EMF Project \(Fact Sheet 181\)](#)
- ▶ [Electromagnetic Fields and Public Health: Physical Properties and Effects on Biological Systems \(Fact Sheet 182\)](#)
- ▶ [Electromagnetic Fields and Public Health: Health Effects of Radiofrequency Fields \(Fact Sheet 183\)](#)
- ▶ [Electromagnetic Fields and Public Health: Public Perception of EMF Risks \(Fact Sheet 184\)](#)
- ▶ [Electromagnetic Fields and Public Health: Mobile Telephones and their Base Stations \(Fact Sheet 193, revised June 2000\)](#)
- ▶ [Video Display Units \(VDUs\) and Human Health \(Fact Sheet 201\)](#)
- ▶ [Electromagnetic Fields and Public Health : Extremely Low Frequency \(ELF\) \(Fact Sheet 205\)](#)
- ▶ [Electromagnetic Fields and Public Health : Radars and Human Health \(Fact Sheet 226\)](#)
- ▶ [Electromagnetic Fields and Public Health: Cautionary Policies \(WHO Backgrounder, March 2000\)](#)
- ▶ [Electromagnetic Fields and Public Health: Extremely low frequency fields and cancer \(Fact Sheet No. 263, October 2001\)](#)

Press Releases and Statements

- ▶ [Scientists Meet in Moscow to Discuss Adverse Health Effects of Electromagnetic Fields](#)
- ▶ [More Information Necessary to Establish Health Effects of Mobile Phones](#)
- ▶ [Clarification of mooted relationship between mobile telephone base stations and cancer \(Statement WHO/1, 23 January 2002\)](#)
- ▶ [Precautionary Measures: A clarification \(5 February 2002\)](#)

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Nota descriptiva n° 183

Mayo 1998

CAMPOS ELECTROMAGNÉTICOS Y SALUD PÚBLICA

Efectos de los campos de radiofrecuencias en la salud

- *Un análisis científico emprendido por la OMS en el marco del Proyecto Internacional CEM (Munich, noviembre de 1996) llegó a la conclusión de que, las publicaciones científicas de actualidad no prueban fehacientemente que la exposición a radiofrecuencias acorte la vida humana, o produzca cáncer o lo favorezca.*

Nota descriptiva N° 193**Revisado en Junio del 2000****CAMPOS ELECTROMAGNÉTICOS Y SALUD PÚBLICA****Los teléfonos móviles y sus estaciones de base**

Conclusiones y Recomendaciones

Ninguna de las recientes revisiones han concluido en que la exposición a campos de RF debido a teléfonos móviles o a las estaciones bases de los mismos tengan algún tipo de consecuencia adversa en la salud. Sin embargo, se han identificado vacíos en las investigaciones que han determinado la ampliación de las investigaciones para hacer mejores evaluaciones de los riesgos contra la salud. Llevará de 3 a 4 años para ser completados, evaluados y publicados los resultados finales para cualquier riesgo . Por el momento la OMS recomienda:

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Los campos electromagnéticos y la salud pública

Estaciones de base y tecnologías inalámbricas

Nota descriptiva N°304

Conclusiones

Teniendo en cuenta los muy bajos niveles de exposición y los resultados de investigaciones reunidos hasta el momento, no hay ninguna prueba científica convincente de que las débiles señales de RF procedentes de las estaciones de base y de las redes inalámbricas tengan efectos adversos en la salud.

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About electromagnetic fields	This handbook is intended to support decision-makers faced with a combination of public controversy, scientific uncertainty, and the need to operate existing facilities and/or the requirement to site new facilities appropriately. Its goal is to improve the decision-making process by reducing misunderstandings and improving trust through better dialogue. Community dialogue successfully implemented helps to establish a decision-making process that is open, consistent, fair and predictable. It can also help achieve the timely approval of new facilities while protecting the health and safety of the community.
EMF Project	
Research	
Standards	
EMF publications & information resources	Originally published in English by WHO in 2002, it has since has been translated into Bulgarian , Dutch , French , German , Italian , Japanese , Portuguese , Russian and Spanish .
Meetings	It has also been used as an information tool by several organizations, such as Elettra 2000 in Italy.

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Health is a state
of complete physical,
mental, and social
well-being and
not merely the
absence of disease
or infirmity.



THANK YOU
FOR YOUR ATTENTION

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