

Webinar on "*5G : State of knowledge and EMF exposure level*"
Télécom Paris, Institut Polytechnique de Paris

Radiofrequency Electromagnetic Fields and Health

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Outline



- Introduction
- 5G in the context of wireless networks development
- Risk assessment: evaluating the health risks from RF EMF
- Risk management: international and national level
- Risk communication and perception
- Discussion

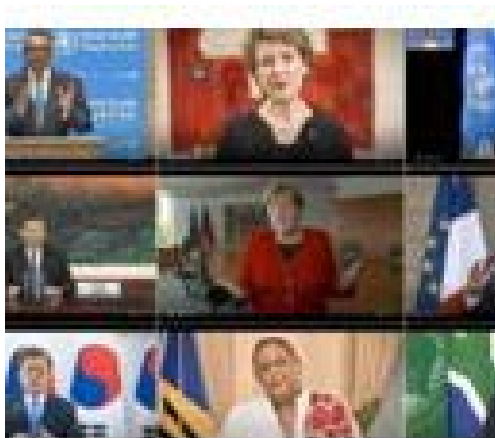
The World Health Organization

- Established on **7 April 1948**
- **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



The WHO 3-level structure

- 7000 people work for WHO in
- 150 WHO offices in countries, territories and areas,
- 6 regional offices,
- at IARC, and
- at the headquarters (Geneva)



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.



WHO's core functions

1. Articulate ethical and evidence-based **policy positions**
2. Setting **norms and standards**, and promoting and monitoring their implementation
3. Shaping the **research agenda**, and stimulating the generation, translation and dissemination of valuable knowledge
4. Providing **technical support**, catalysing change and developing sustainable institutional capacity
5. **Monitoring** the health situation and assessing health trends
6. Providing **leadership** on matters critical to health and engaging in **partnerships** where joint action is needed

HOW THE ENVIRONMENT IMPACTS OUR HEALTH

People are exposed to risk factors in their homes, work places and communities through:



AIR POLLUTION
including indoors and outdoors



INADEQUATE WATER, SANITATION and hygiene



CHEMICALS
and biological agents



RADIATION
ultraviolet and ionizing



COMMUNITY NOISE



OCCUPATIONAL RISKS



CLIMATE CHANGE



BUILT ENVIRONMENTS
including housing and roads



AGRICULTURAL PRACTICES
including pesticide-use, waste-water reuse



POWER LINES



TRAINS



RADAR

0 Hz 10² 10⁴ 10⁶ 10⁸ 10¹⁰ 10¹²

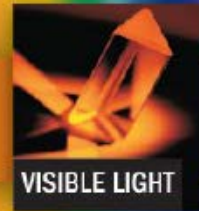
FREQUENCY (Hz OR CYCLES PER SECOND)



PERSONAL COMPUTER



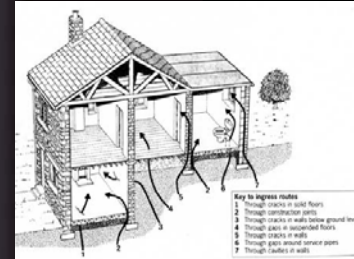
CELL PHONE



VISIBLE LIGHT



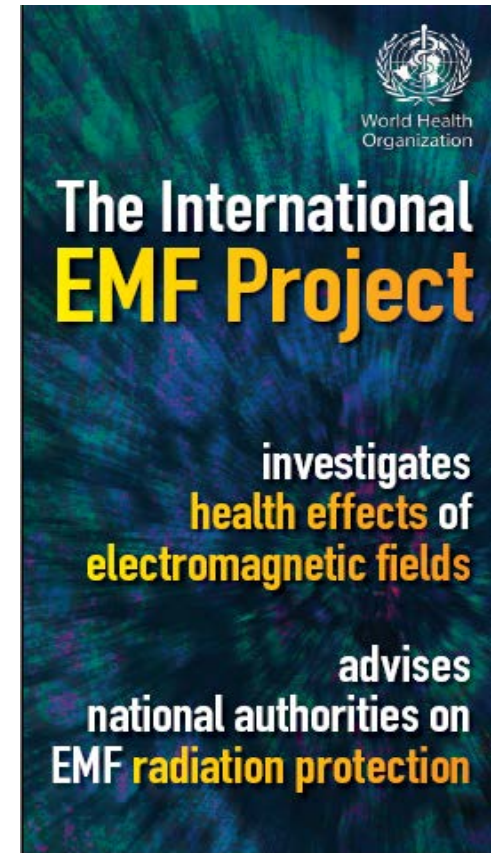
X-RAY



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**
- **Membership**
 - Open to any WHO Member State government department or representatives of national institutions concerned with radiation protection
 - Over 60 national authorities have been involved in the Project



Partners



Outline

- Introduction
- **RF applications: present and near future (5G)**
- Risk assessment: evaluating the health risks from RF EMF
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Applications using radiofrequency fields (100 kHz – 300 GHz)



Telecommunications

Navigation/Radar

Broadcasting

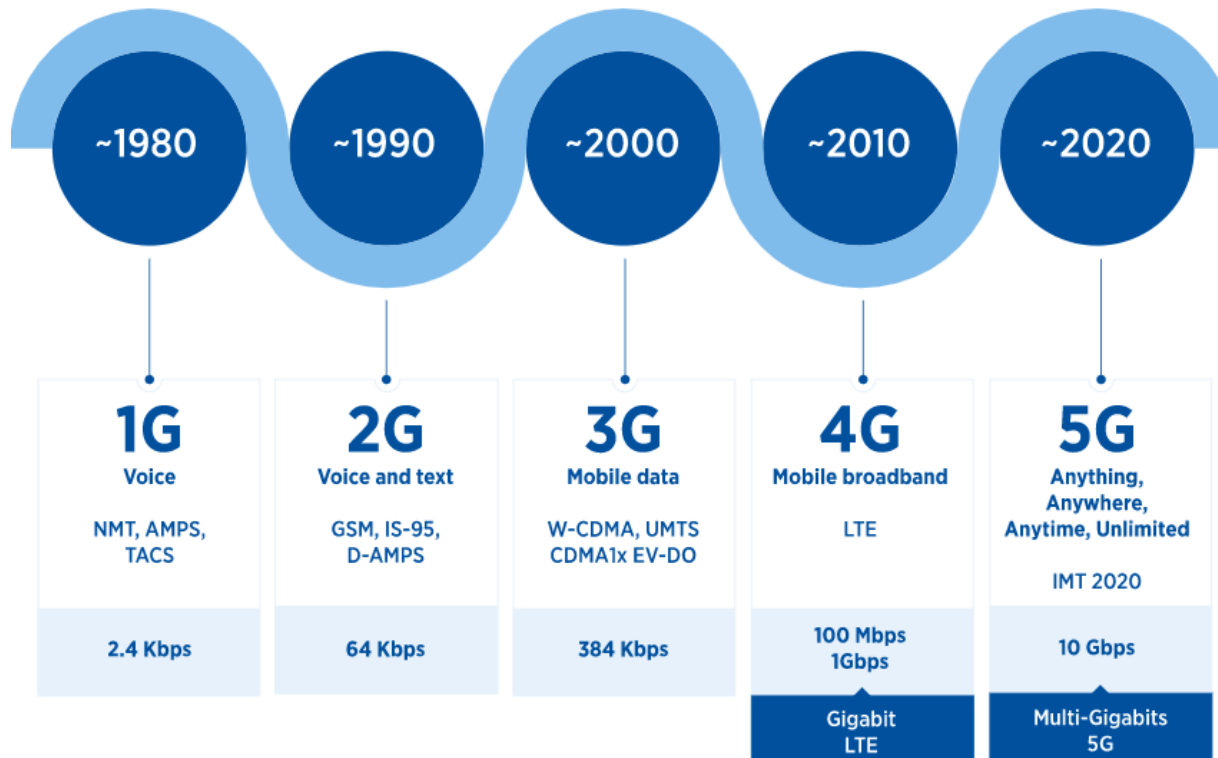
Commercial



Residential sources



Wireless technologies



NEW APPLICATIONS

5G IS PRESENTED AS THE NEW GENERATION OF MOBILE NETWORK INFRASTRUCTURE ENABLING A GIANT LEAP IN PERFORMANCE AND A WIDE RANGE OF APPLICATIONS.



E-HEALTH

Telemedicine
Remote surveillance
Telesurgery



MEDIA & ENTERTAINMENT

Ultra HD video
Integrated immersive media
Virtual reality
User content



TRANSPORT

Autonomous vehicles
Intelligent transport systems (ITS)
Car-to-car communication



INETELLIGENT CITIES

Energy management
Public security
Connected territories



SPEED

5G promise to accelerate data transfer speeds by up to 10 times versus 4G.

LATENCY

With a ten-fold decrease, low latency opens new opportunities and usages requiring rapid responsiveness, especially for professionals.

DENSITY

5G will increase connection density enabling 10 times more objects to be simultaneously connected to the network.

TOMORROW INDUSTRY

Robotics
Remote piloting
Automation



https://www.anfr.fr/fileadmin/mediatheque/documents/5G/ANFR_5G-EN.pdf

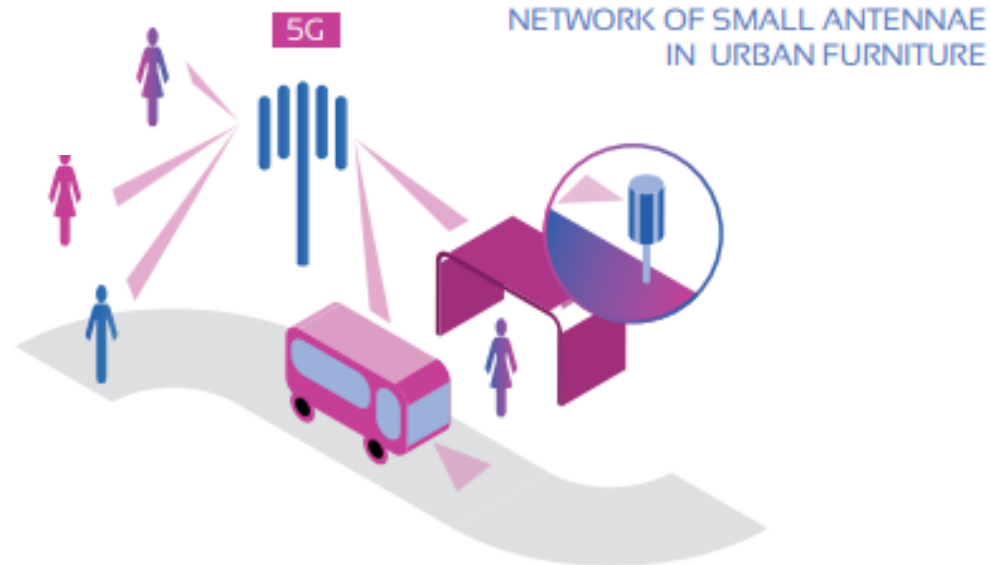
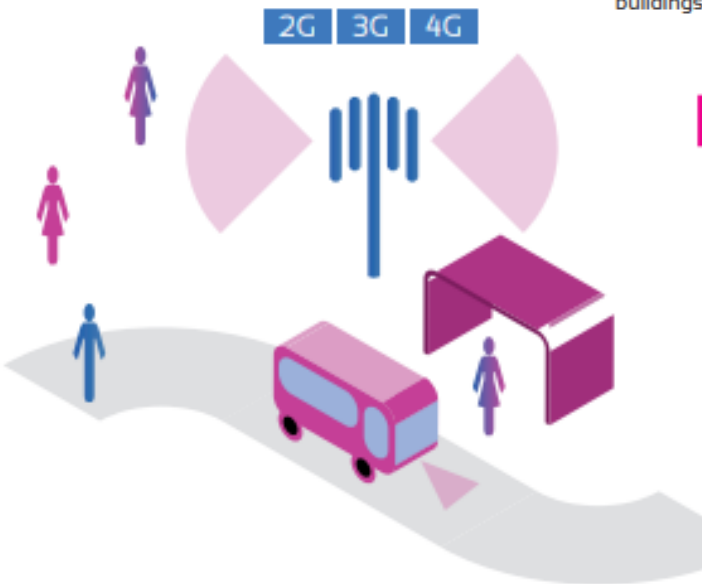
5G frequency spectrum

NEW FREQUENCY BANDS



5G infrastructure

5G will be deployed using existing operator infrastructure, as well as intelligent and small antennae installed in urban furniture or inside buildings.



CURRENT INFRASTRUCTURE

Current mobile networks use antennae that constantly transmit signal in all directions.

INTELLIGENT ANTENNAE

A new generation of antennae directs signals towards the devices that need them. Combined with high frequency bands, these antennae will significantly increase transfer speeds.

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The Present Scientific Knowledge



- **Known biological mechanisms of interaction**
- **Large research databases and sophisticated dosimetric models**
- **International exposure guidelines based on established health effects**
- **.... But remaining scientific uncertainty**

What do we know?

100 kHz

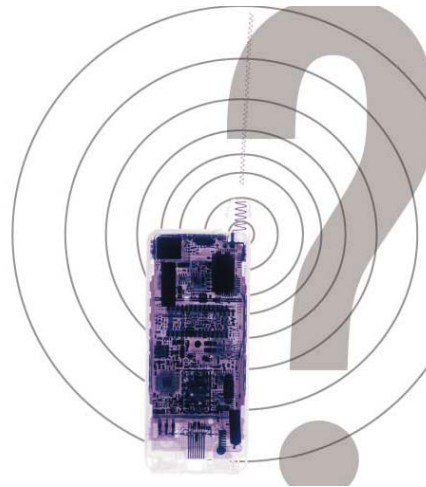
300 MHz

10 GHz

Frequency

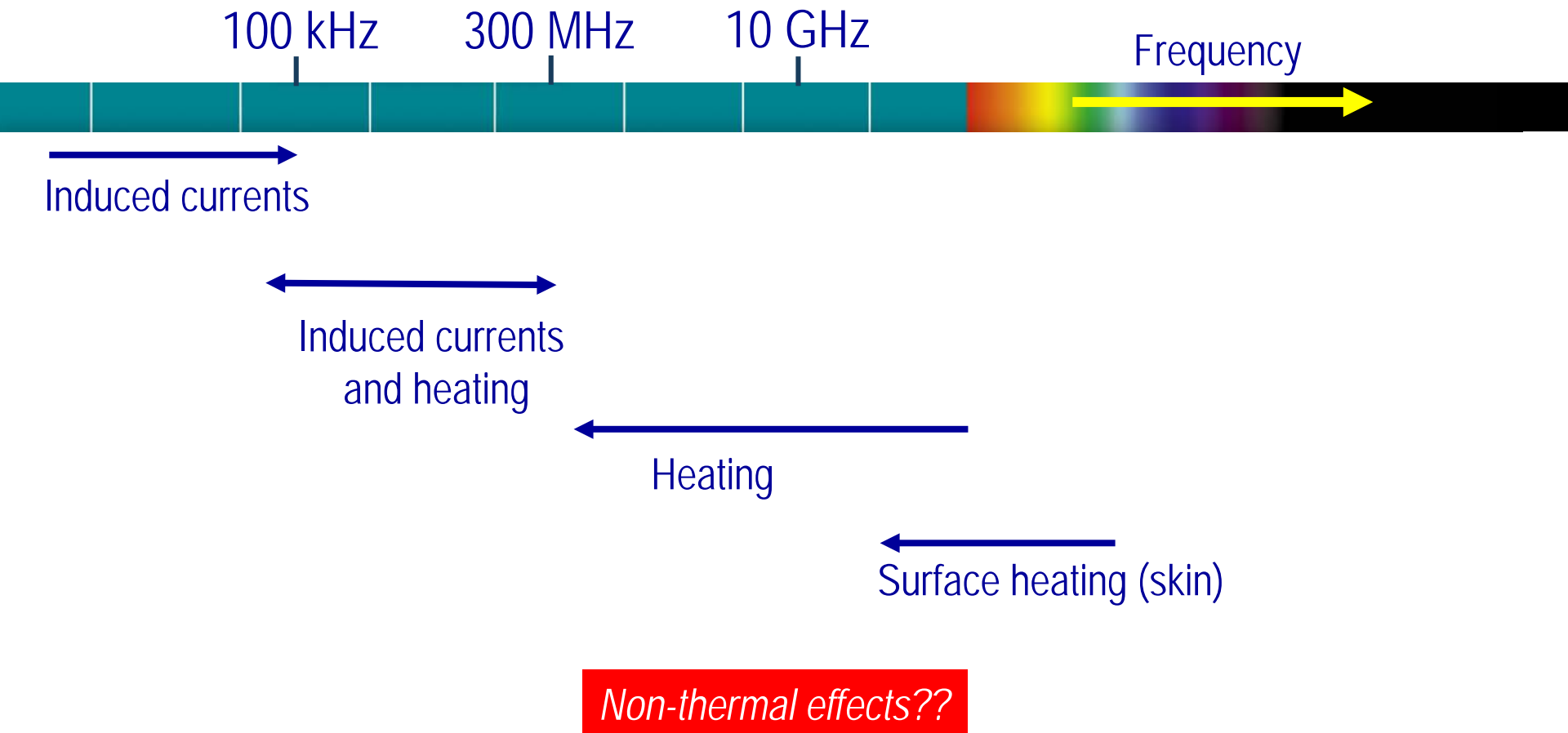


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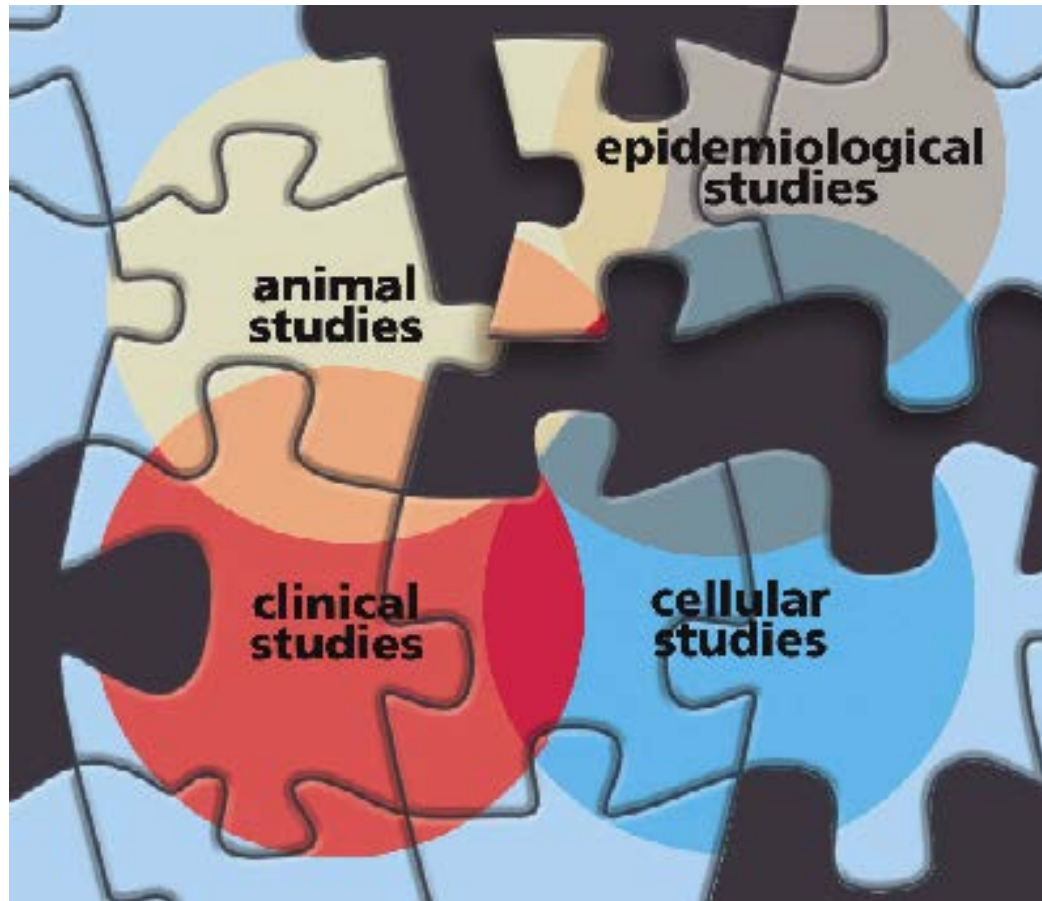
What do we know?

Mechanisms of interaction



Evaluating the health risks

Review of research



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



How do we evaluate the health risk from EMF?

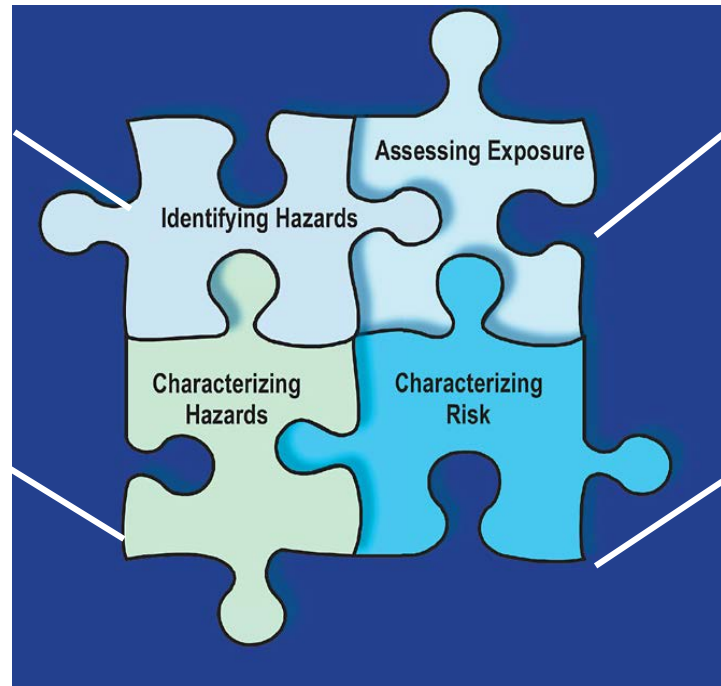
Health Risk Assessment

1. Hazard identification

What is the agent and what health problems can it potentially caused?

3. Dose-response relationship

What are the health problems at different exposure levels?



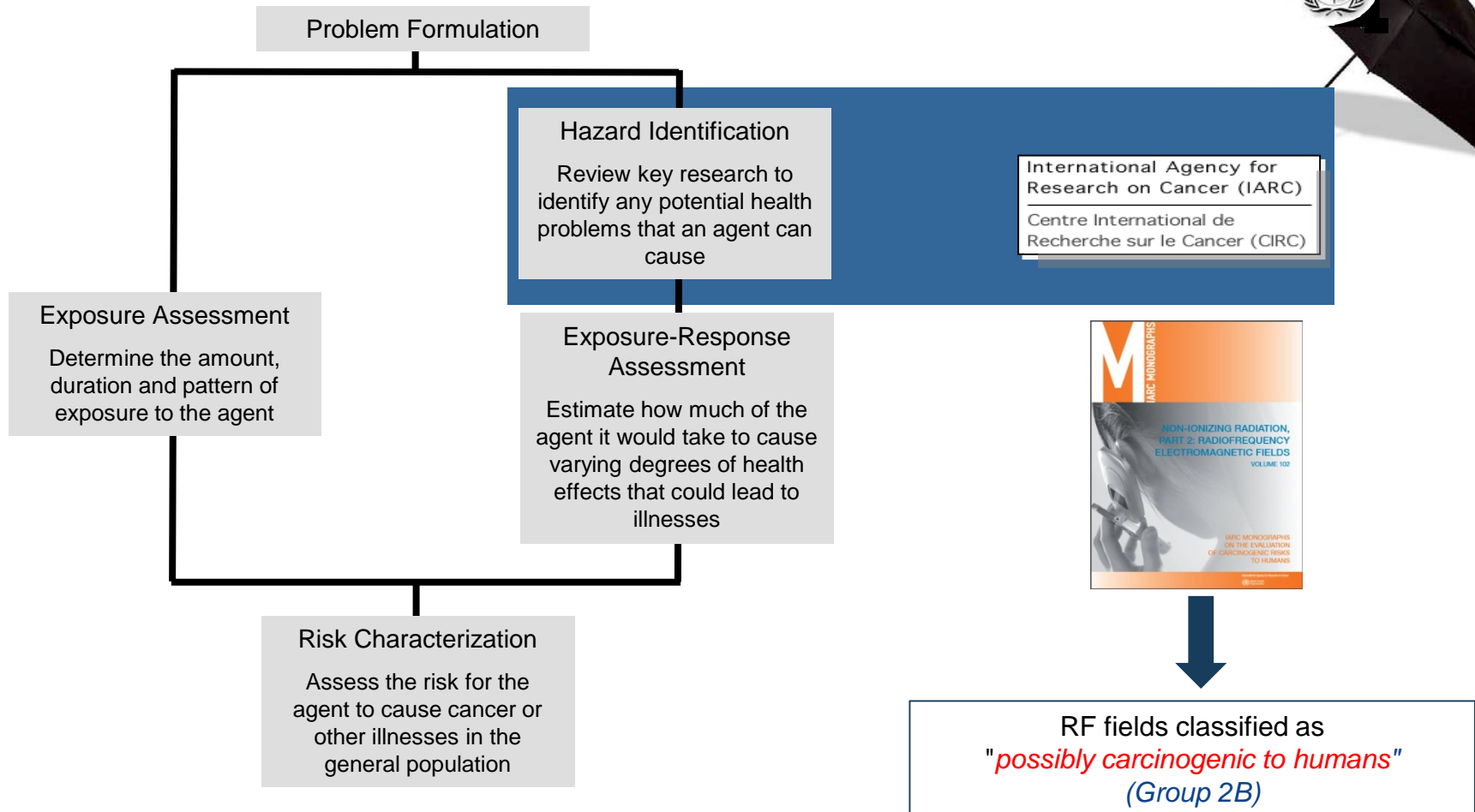
2. Exposure assessment

What exposures are likely to occur, and what is the resulting dose to humans?

4. Risk characterization

What is the health risk in the exposed population?

Health Risk Assessment

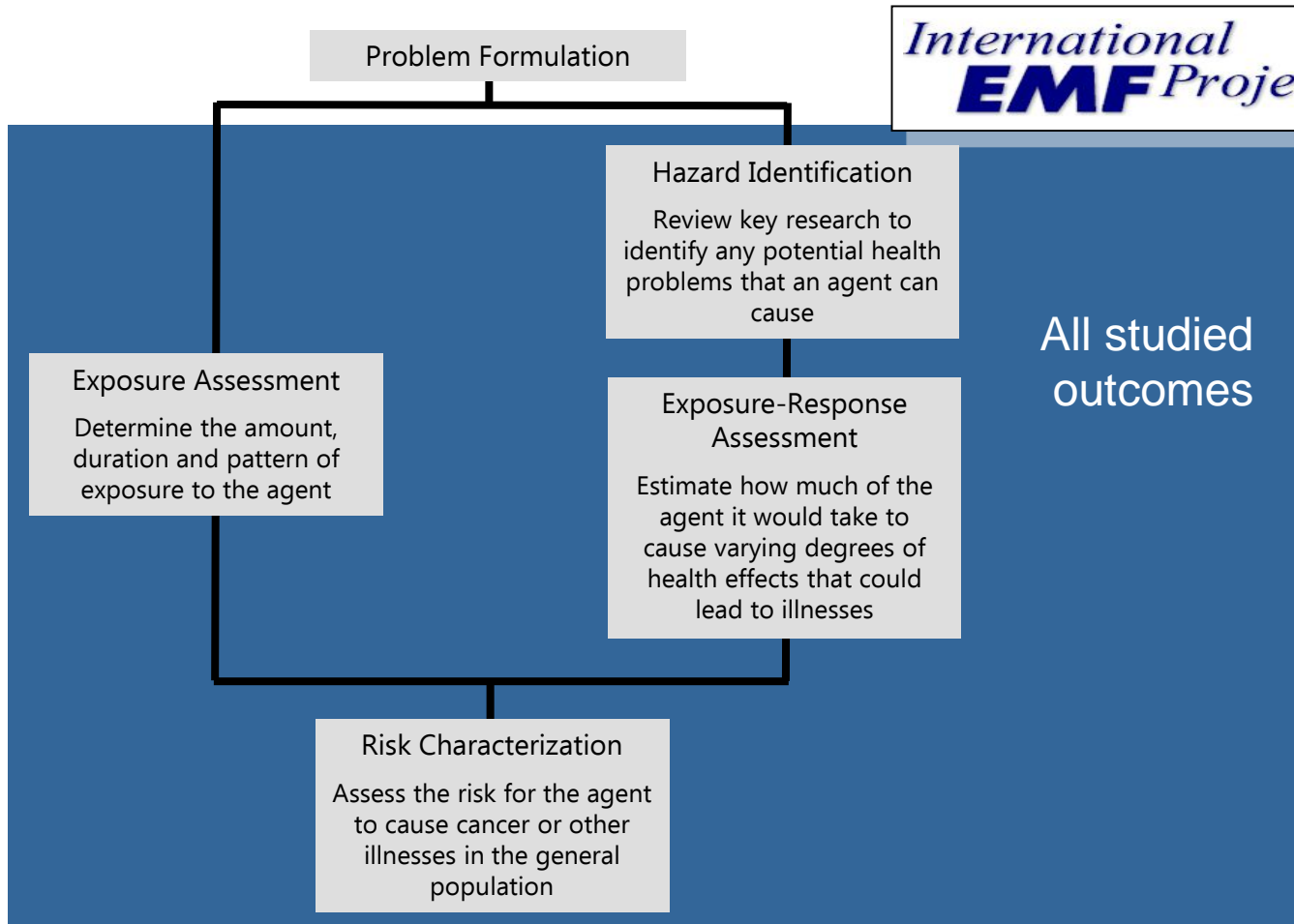
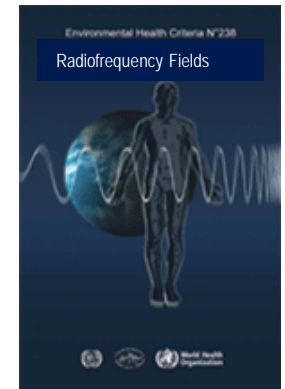


Health Risk Assessment (cont'd)



International
EMF Project

All studied
outcomes



WHO Health Risk Assessment

Radiofrequency Fields



- Development of a narrative review (2012-17)
 - International survey of radiofrequency policies
 - International stakeholders meeting
 - Online first draft for comments
 - Incorporation of comments
 - WHO request for systematic review process (methodologist)
 - Update of draft with latest publications
- International survey to prioritize health outcomes (2018)
- Call for expressions of interest (2019-20)

Call for Expression of Interest (2019)

The World Health Organization's (WHO) Radiation Programme has an ongoing project to assess potential health effects of exposure to radiofrequency electromagnetic fields in the general and working population. To prioritize potential diverse health outcomes, WHO conducted a broad [international survey](#) in 2018. Ten major topics were identified for which WHO will now commission systematic reviews to analyze and synthesize the available evidence.

Through this Call, WHO invites eligible teams to indicate their interest in undertaking a systematic review on one (or more) of the following topics:

↓ [SR1 – Cancer \(human observational studies\)](#)
⇒ pdf, 525kb

↓ [SR2 – Cancer \(animal studies\)](#)
⇒ pdf, 628kb

↓ [SR3 – Adverse reproductive outcomes \(human observational studies\)](#)
⇒ pdf, 634kb

↓ [SR4 – Adverse reproductive outcomes \(animal and in vitro studies\)](#)
⇒ pdf, 633kb

↓ [SR5 – Cognitive impairment \(human observational studies\)](#)
⇒ pdf, 633kb

↓ [SR6 – Cognitive impairment \(human experimental studies\)](#)
⇒ pdf, 633kb

↓ [SR7 – Symptoms \(human observational studies\)](#)
⇒ pdf, 631kb

↓ [SR8 – Symptoms \(human experimental studies\)](#)
⇒ pdf, 631kb

↓ [SR9 – Effect of exposure to RF on biomarkers of oxidative stress](#)
⇒ pdf, 628kb

↓ [SR10 – Effect of exposure to heat from any source on pain, burns, cataract and heat-related illnesses](#)
⇒ pdf, 526kb

WHO Environmental Health Criteria Radiofrequency Fields



Appraisal of the evidence for health risks associated with exposure to RF fields to result in several publications.

- A technical report as a scoping review of the **scientific literature of studied health outcomes**.
- A series of **systematic reviews** on priority health outcomes to be published in a special issue of *Environment International*
- The **RF EHC monograph** will elaborate on the health outcomes highlighted in the review process, using procedures for guideline development as recently required by WHO.
- A **Task Group** will be tasked with finalizing conclusions on all health outcomes reviewed, as well as developing research recommendations, and a health risk assessment.

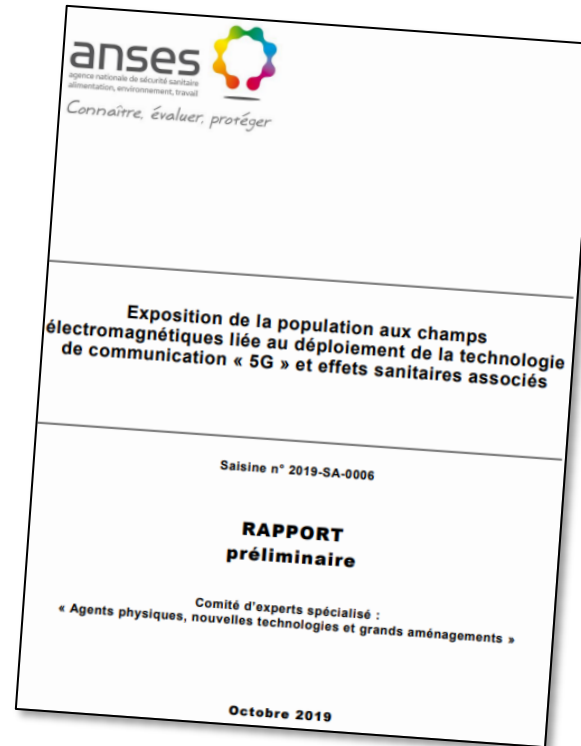


5G and health?

- Millimetre waves are absorbed within mm of the skin surface (unlike RF energy at lower frequencies which can penetrate into tissue)
- Thermal effect still relevant
- A number of exploratory studies, but not necessarily targeted at possible health risks
- A lot of media attention
- Level of citizen concern varies between countries
- Targeted reviews of the scientific evidence in a number of countries (e.g. France ANSES, Netherlands HCN, ...)

Reviews on health aspects of 5G

National examples



WHO and 5G

- WHO Questions and Answers (27 February 2020)
<https://www.who.int/news-room/q-a-detail/5g-mobile-networks-and-health>

What is 5G?



What are the main differences between 5G and previous technologies?



Exposure levels



What are the potential health risks from 5G?



What are the international exposure guidelines?



What is WHO doing?

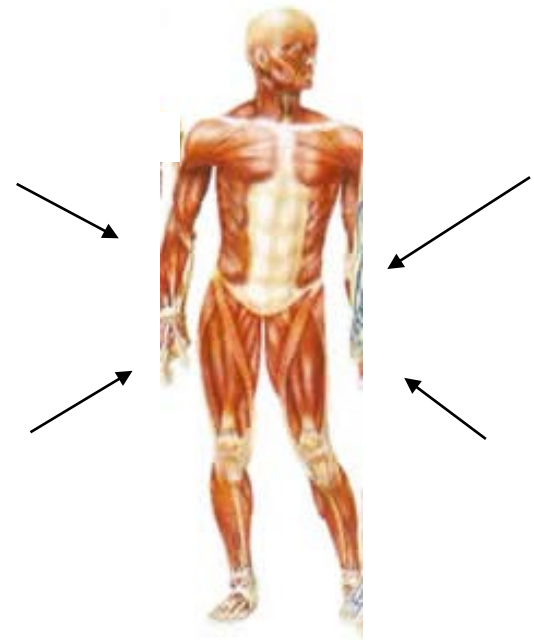
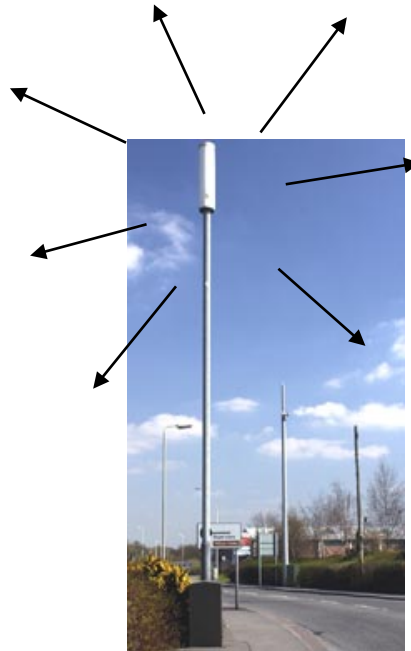
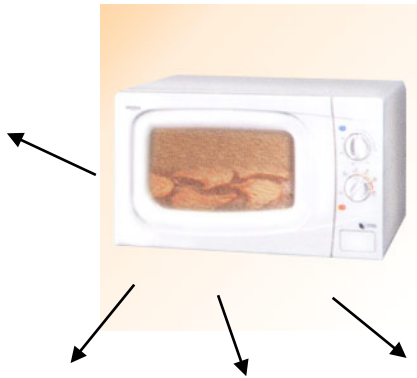


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Standards and Guidelines

- **Emission standards** have specifications that limit the EMF emissions from devices
- **Exposure standards** have specifications that limit EMF exposure to people



Standards and Guidelines

- Emission standards
- Measurement standards
- Exposure standards



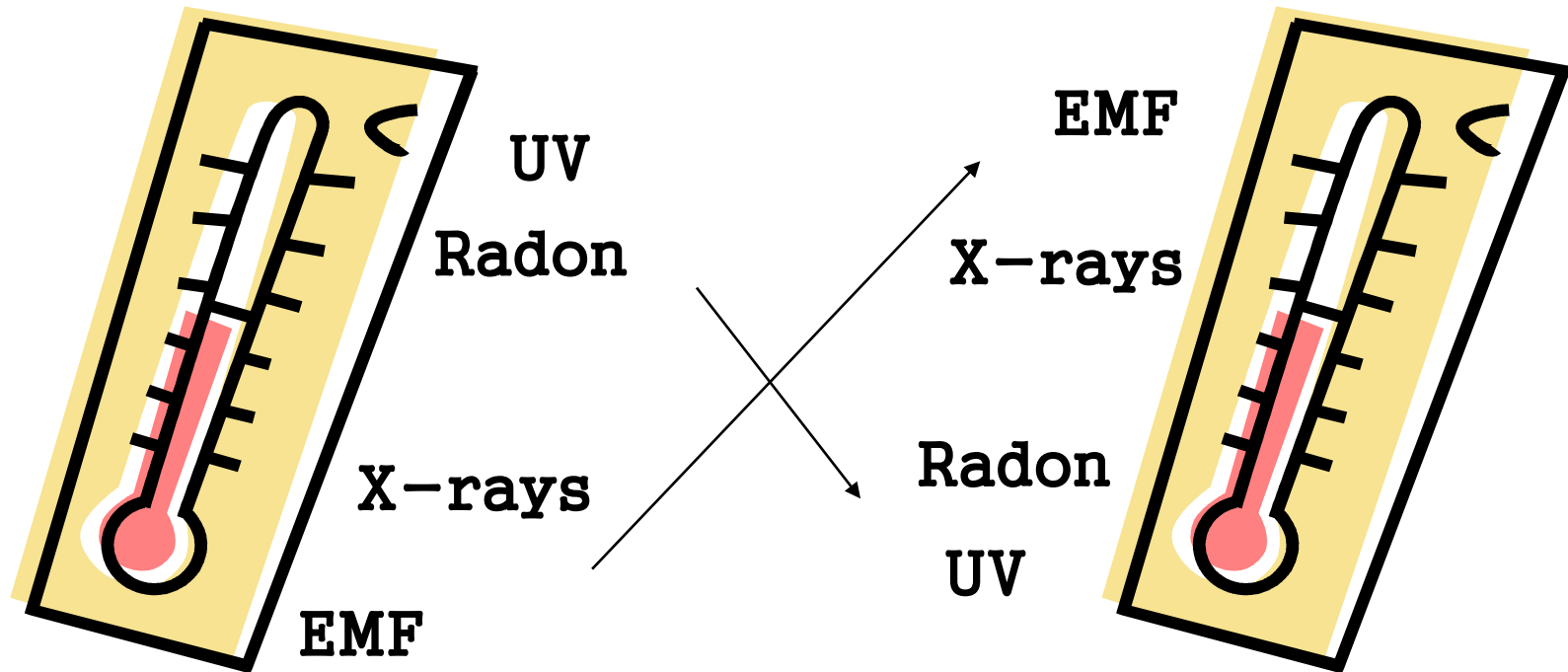
Radiation

Risk Communication



Public Health

Public Concern





Mobiles 'boost cancer'

Radiation may make tumours

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

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...



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SCIENCE

How bad science stoked 5G fears

An inaccurate chart drawn by an ill-informed scientist grew into a cancer scare

BY WILLIAM J. BROAD

In 2000, the Broward County Public Schools in Florida received an alarming report. Like many affluent school districts at the time, Broward was considering laptops and wireless networks for its classrooms and 250,000 students. Were there any health risks?

The district asked Bill P. Curry, a consultant and physicist, to study the matter. The technology, he reported back, was "likely to be a serious health hazard."

He summarized his most troubling evidence in a large graph labeled "Microwave Absorption in Brain Tissue (Grey Matter)."

The chart showed the dose of radiation received by the brain rising from left to right as the frequency of a wireless signal increased. The slope was gentle at first, but when the line reached the wireless frequencies associated with computer networking, it shot straight up, indicating a dangerous level of exposure.

"This graph shows why I am concerned," Dr. Curry wrote. The body of his report detailed how the radio waves could sow brain cancer, a terrifying disease that kills most of its victims.

Dr. Curry's warning spread, resonating with educators, consumers and entire cities as the frequencies of cellphones, cell towers and wireless local networks rose. To no small degree, owing anxiety over 5G technology can be traced to a single scientist and a sin-chart.

But Dr. Curry and his graph got it wrong.

According to experts on the biological effects of electromagnetic radiation, radio waves become safer at higher frequencies, not more dangerous. (Excessively high-frequency energies, such as X-rays, behave differently and do a health risk.)

In his research, Dr. Curry looked at how radio waves affect tissue isolated in the lab. He misinterpreted the results as ap-



sought to force the Portland, Ore., public schools to abandon their wireless computer networks. The suit had been filed by a worried parent.

As an expert witness, Dr. Carpenter said in a legal declaration on Dec. 20, 2011, that the graph showed how the brain's absorption of radio-wave energy "increases exponentially" as wireless frequencies rise, calling it evidence of grave student danger. The graph "illustrates the problem with the drive of the wireless industry toward ever higher frequencies," he said.

In response to such arguments, the industry noted that it obeyed government safety rules. The judge in the Portland case said the court had no jurisdiction over federal regulatory matters and dismissed the lawsuit.

Despite the setback, Dr. Carpenter's 2011 declaration, which included Dr. Curry's graph, kept drawing attention. In 2012, he introduced it as part of his testimony to a Michigan state board assessing wireless dangers, and it soon began circulating online among wireless critics.

And he saw a new danger. Between 2010 and 2012, the frequencies of the newest generation of cellphones, 4G, rose past those typical of the day's wireless networks. Dr. Carpenter now had a much larger and seemingly more urgent target, especially since cellphones were often held snugly against the head.

But mainstream science rejected his conclusions. Two Oxford University researchers described them as "scientifically discredited."

A 'FACT' IS BORN

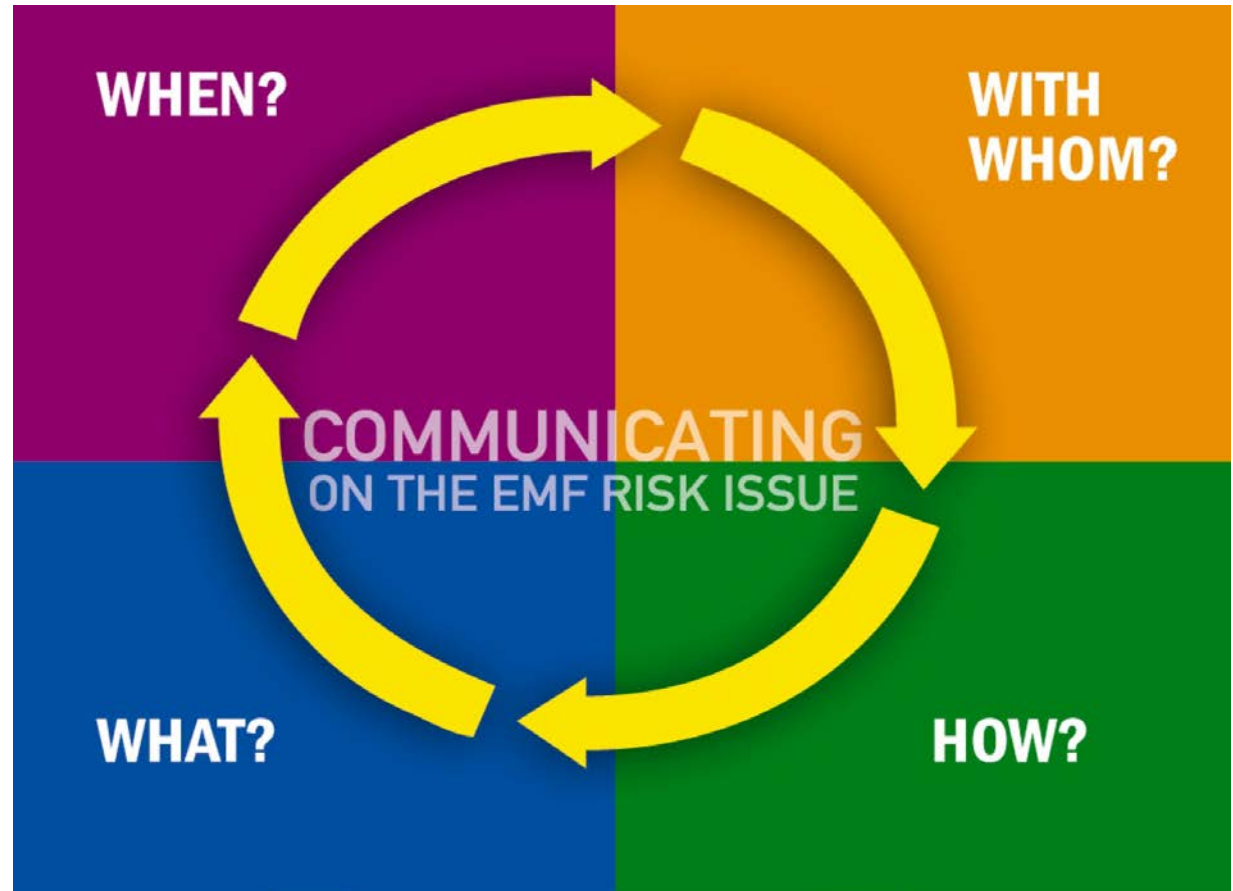
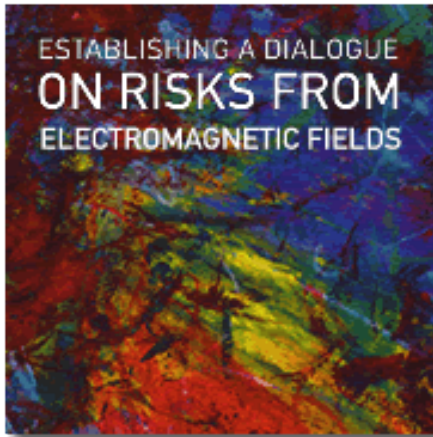
Unbowed, Dr. Carpenter worked hard to revise established science. In 2012, he became editor in chief of *Reviews on Environmental Health*, a quarterly journal. He published several authors who filed alarmist reports, as well as his own.

"The rapid increase in the use of cell phones increases risk of cancer, male infertility, and neurobehavioral abnormalities," Dr. Carpenter wrote in 2013.

As the frequencies of wireless devices continued to rise, an associated risk of brain cancer was repeated uncritically often without attribution to Dr. Curry or Dr. Carpenter. It came to be regarded by activists as an established fact.

"The higher the frequency, the most dangerous," according to *Radiation*

Managing EMF Risk Communication



Information provision on 5G National examples



Homepage > Topics > Electromagnetic fields > Radiation protection in mobile communication > What is mobile communication? > 5G

ELECTROMAGNETIC FIELDS

Mobile communication, WLAN & Co. - Grid expansion - Household appliances & electric installations

5G

The next generation (5G) of mobile phones will be available from 2020. Self-driving cars, voice-activated assistants, and intelligent refrigerators are just a few examples of how the higher data transmission rates of the new mobile phone technology could be used. However, there are also some concerns. This includes, in particular, the question of whether the expansion of 5G also entails a health risk. According to the current state of scientific knowledge, the Federal Office for Radiation Protection (BfS) does not anticipate negative health effects but does see some open questions.

Home > 5G technologies: radio waves and health

Guidance 5G technologies: radio waves and health

Published 3 October 2019

Contents

- Public exposure
- 5G frequencies
- Research studies
- Summary

Mobile telecommunications technology has developed through several generations and there are now many 2G, 3G and 4G base stations installed throughout the environment providing services to users of mobile phones and other devices.

Australian Government
Australian Radiation Protection and Nuclear Safety Agency

arpana

Enter your keywords

Home Understanding radiation Our services Regulation and licensing Research and expertise About us

Home > 5G: the new generation of the mobile phone network and health

In this section

5G: the new generation of the mobile phone network and health

Home

Understanding radiation 20 March 2019



PUBLIC TRUST AND DEPLOYING 5G NETWORKS



INFORME

The deployment of new technologies needs to be accompanied by objective information that answers the public's questions and avoids the spread of false ideas. It is therefore essential to explain, clearly and transparently as possible, what 5G is, its impact on our health and the steps taken to guarantee the network is secure with no interference.

MONITOR

The ANFR oversees a national programme to monitor and measure public exposure to high-frequency waves, ensuring that the limits are respected. Present on the ground, the organisation also supports different frequency users in coexisting harmoniously and mediates any disputes.



DIALOGUE

The ANFR's Comité national de dialogue (National Dialogue Committee) is a dedicated arena for different players to exchange and share information to increase public confidence. At a local level, the ANFR accompanies authorities in deploying 5G and managing public exposure to waves.

COMMUNICATE

The "5G pilots" enable the organisation to carry out on-the-ground studies and measure levels of exposure to high-frequency waves. The results are available at www.anfr.fr



1

5G is the **5th generation** in mobile phone technology.

2

5G emits radio waves, also called **radiofrequency electromagnetic energy (RF EME)**.

3

There are **no established short term or long term health effects** to people or the environment from radio waves at the power levels used for 5G.

4

5G will initially use the same type of radio waves as 4G. In the future, 5G will use '**millimetre waves**'. Millimetre waves cannot travel as far as those used in 4G, so **more small cell base stations are required**.

5

ARPANSA maintains the health standard for all RF EME. The Standard is consistent with **international best practice** and is reviewed regularly as new research emerges.

Questions

- **What exposures are expected?**
 - From the wireless networks?
 - From the devices?
- **What research is planned to assess potential health effects?**
- **What are governments doing to handle the (risk) communication aspects?**
- **What should be done by manufacturers/operators to handle the (risk) communication aspects?**
- **Are stakeholders involved in a dialogue?**

HEALTH

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

(WHO Constitution, 1948)

Other aspects....

Environment

Sustainable development

Social dimension

Civil society debate

Information

Economy

Industry

Technology /
Telecommunications

Finance

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

- Balancing any potential risks with major benefits from digital technologies for health (e-health, m-health, artificial intelligence, ...)

WHO COVID-19 myth buster

Viruses cannot travel on radio waves/mobile networks.

COVID-19 is spreading in many countries that do not have 5G mobile networks.

COVID-19 is spread through respiratory droplets when an infected person coughs, sneezes or speaks.

People can also be infected by touching a contaminated surface and then their eyes, mouth or nose.

FACT:
5G mobile networks
DO NOT spread COVID-19

