

ITU Regional Seminar for Europe and CIS on  
Spectrum Management and Broadcasting



# Radiofrequency Electromagnetic Fields and Health

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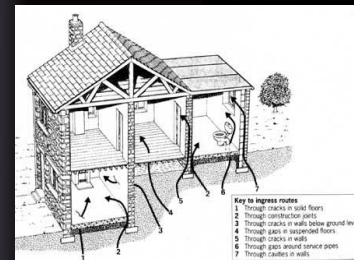
POWER LINES



RADAR

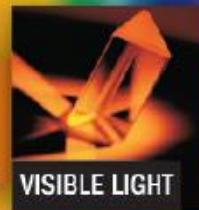


TRAINS



0 Hz    10<sup>2</sup>    10<sup>4</sup>    10<sup>6</sup>    10<sup>8</sup>    10<sup>10</sup>    10<sup>12</sup>

FREQUENCY (Hz OR CYCLES PER SECOND)



# Applications using radiofrequency fields (100 kHz – 300 GHz)



Telecommunications

Wi-Fi



Navigation/Radar



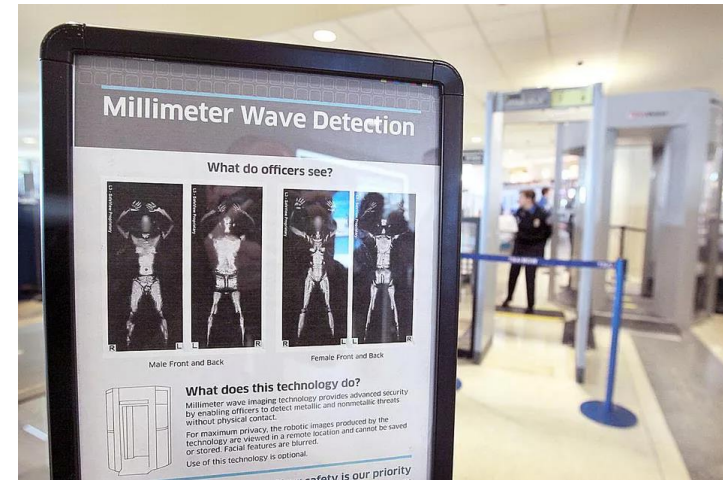
Commercial



Broadcasting

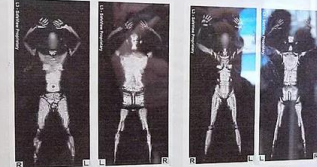


Residential sources



## Millimeter Wave Detection

### What do officers see?



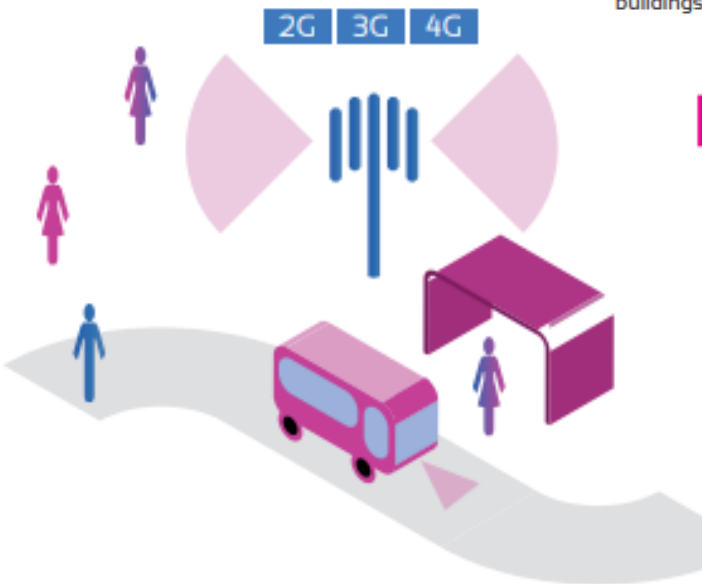
**What does this technology do?**  
Millimeter wave imaging technology provides advanced security by enabling officers to detect metallic and nonmetallic threats without physical contact.  
For maximum privacy, the robotic images produced by the technology are viewed in a remote location and cannot be saved or stored. Facial features are blurred.  
Use of this technology is optional.

... safety is our priority



# 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.

# Mobiles 'boost cancer'

## Radiation may make tumours grow faster

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 of



## Stop Smart Meters!

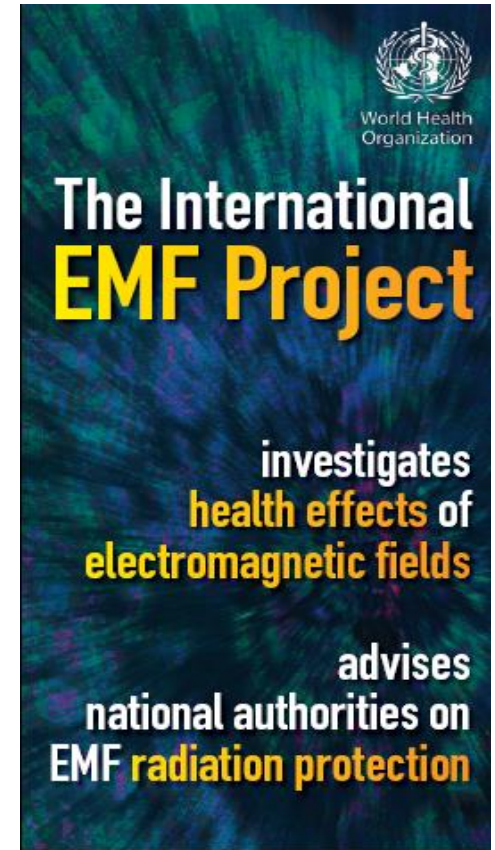
*Fighting for health, privacy, and safety*



# 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





## The Present Scientific Knowledge

A person wearing a white lab coat is seated at a desk in a laboratory or office environment. They are looking at a computer monitor. The desk has several other monitors and a keyboard. In the background, there are shelves and various pieces of equipment, including what appears to be a microscope or similar scientific instrument.

- **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

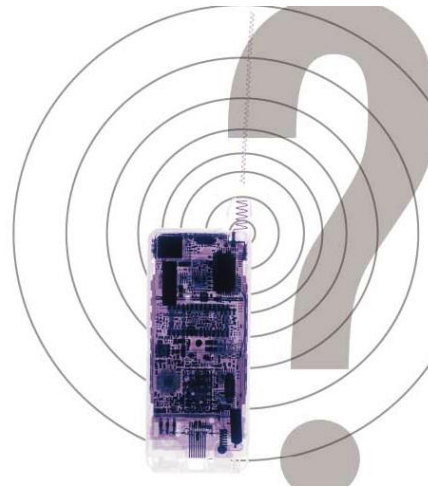
300 MHz

10 GHz

Frequency



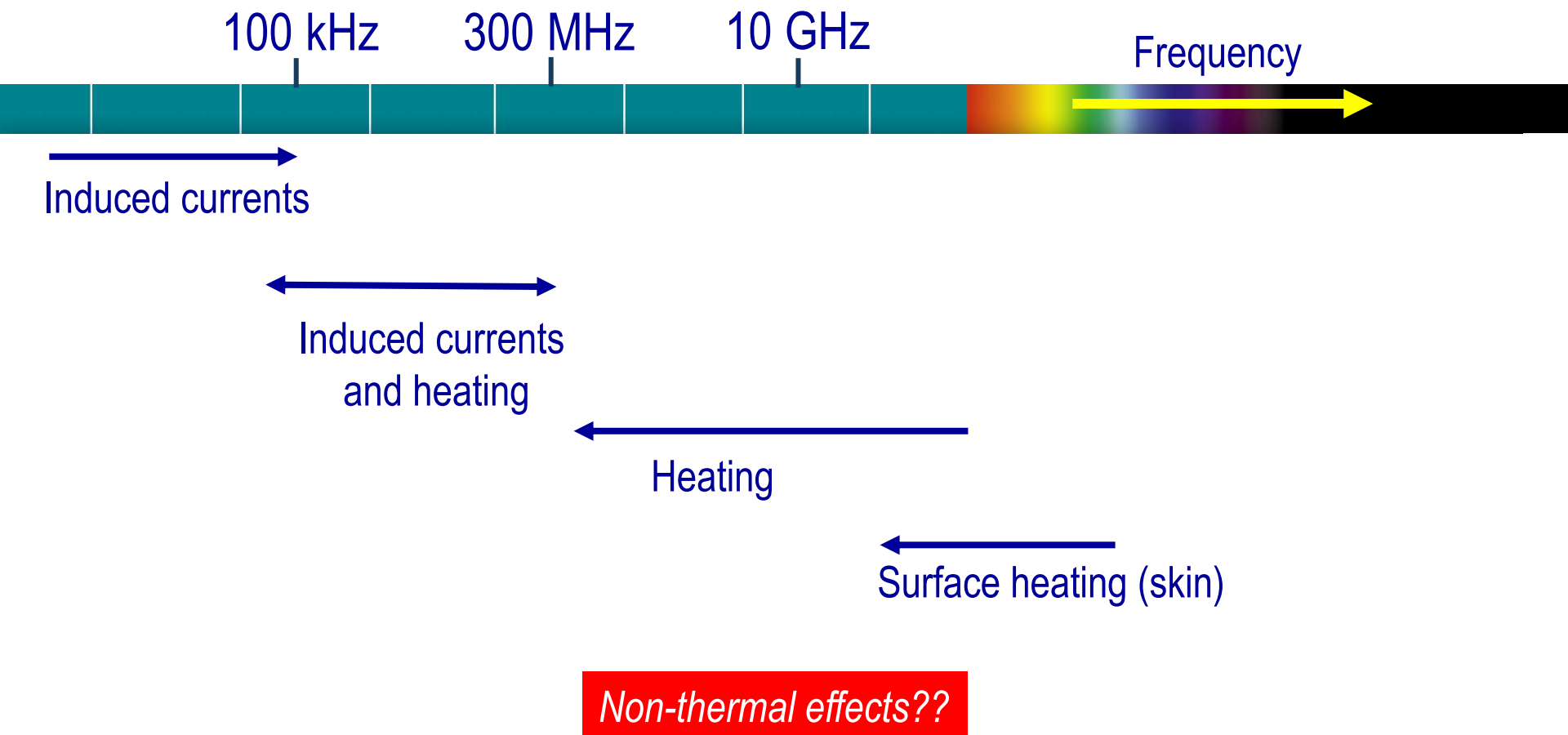
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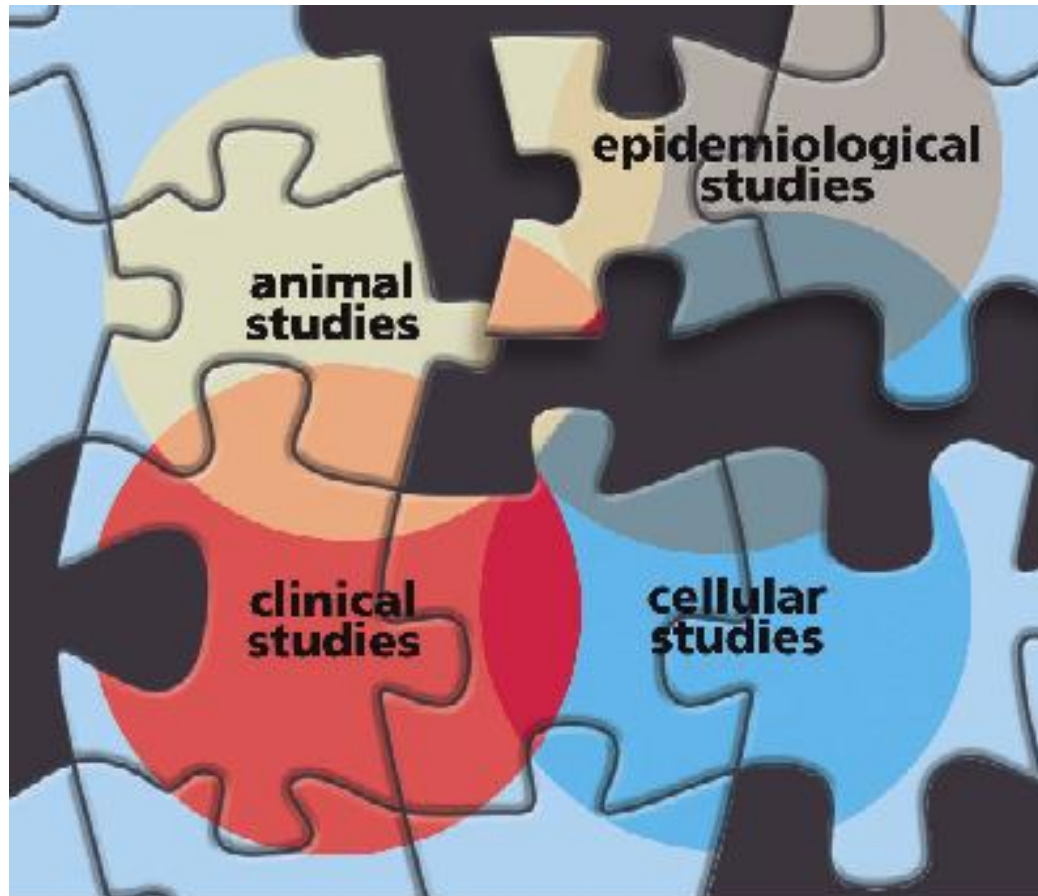
# What do we know?

## Mechanisms of interaction



# Evaluating the health risks

## Review of research



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

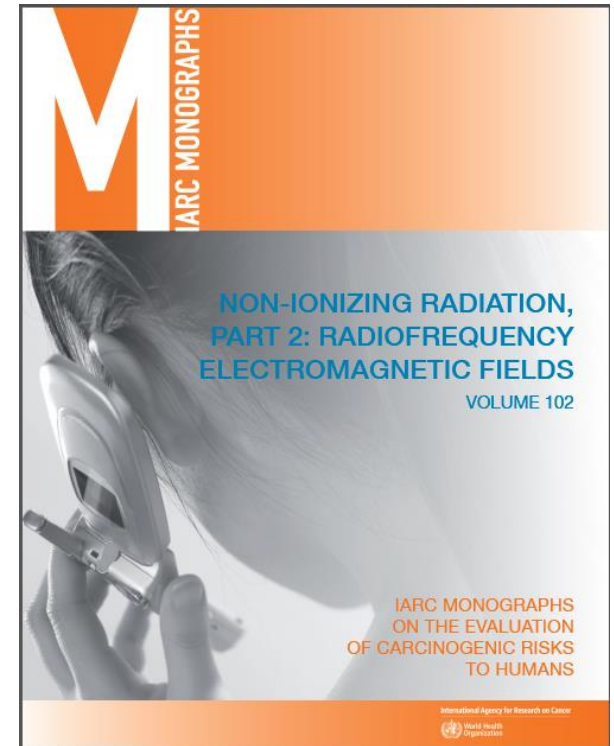
# IARC Evaluation of Radiofrequency Fields Volume 102 (2013)



RF fields classified as "*possibly carcinogenic to humans*" (*Group 2B*) based on

- **limited evidence in humans**, based on positive association between glioma and acoustic neuroma and exposure to RF-EMF from wireless phones (epidemiologic studies)
- **limited evidence in experimental animals** for the carcinogenicity of RF-EMF
- **weak mechanistic evidence** relevant to RF-EMF-induced cancer in humans

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





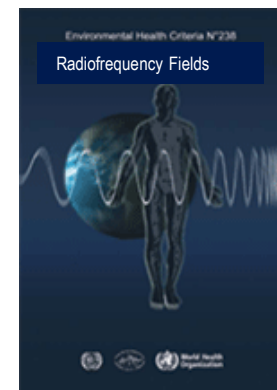
# Radio Frequency fields

## Call for Expressions of Interest for systematic reviews (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 adverse 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



# 5G and health?

- A lot of media attention
- Level of citizen concern varies between countries
- Targeted scientific evidence review ongoing in a number of countries (e.g. France ANSES, Netherlands HCN, ...)

# 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?





# Discussion

## *"5G, EMF & Health"*



- To date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies. Health-related conclusions are drawn from studies performed across the entire radio spectrum but, so far, only a few studies have been carried out at the frequencies to be used by 5G.
- Tissue heating is the main mechanism of interaction between radiofrequency fields and the human body. Radiofrequency exposure levels from current technologies result in negligible temperature rise in the human body.
- As the frequency increases, there is less penetration into the body tissues and absorption of the energy becomes more confined to the surface of the body (skin and eye). Provided that the overall exposure remains below international guidelines, no consequences for public health are anticipated.

# WHO COVID-19 mythbuster

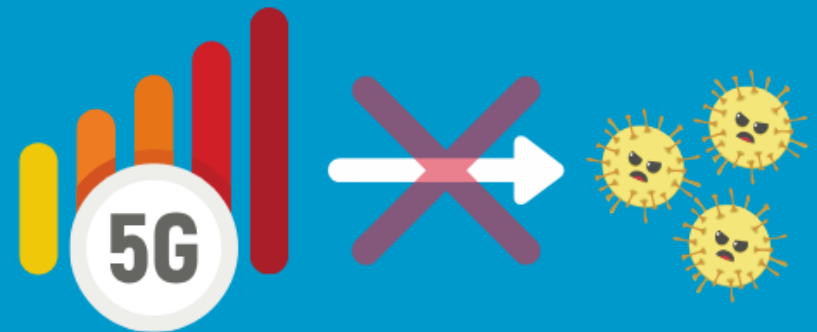
Viruses cannot travel on radio waves/mobile networks.

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



# What is 5G?



5G, or fifth Generation, is the latest wireless mobile phone technology, first widely deployed in 2019. 5G is expected to increase performance and a wide range of new applications, including strengthening e-Health (telemedicine, remote surveillance, telesurgery).



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



5G represents an evolution in telecommunication standards. To enable increased performance, 5G will extend into higher frequencies around 3.5 GHz and up to a few tens of GHz. The higher frequencies are new to mobile phone networks, but are commonly used in other applications, such as point-to-point radio links and body-scanners for security checks.

At these higher frequencies, 5G networks will use a greater number of base stations and of connected objects. 5G will further employ beam-forming antennas to focus signals more efficiently towards the device in use, rather than having the signal spread in broad directions as in current base station antennas.

# Exposure levels



Currently, exposure from 5G infrastructures at around 3.5 GHz is similar to that from existing mobile phone base stations. With the use of multiple beams from 5G antennas, exposure could be more variable as a function of location of the users and their usage. Given that the 5G technology is currently at an early stage of deployment, the extent of any change in exposure to radiofrequency fields is still under investigation.

# What are the potential health risks from 5G?



To date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies. Health-related conclusions are drawn from studies performed across the entire radio spectrum but, so far, only a few studies have been carried out at the frequencies to be used by 5G.

Tissue heating is the main mechanism of interaction between radiofrequency fields and the human body. Radiofrequency exposure levels from current technologies result in negligible temperature rise in the human body.

As the frequency increases, there is less penetration into the body tissues and absorption of the energy becomes more confined to the surface of the body (skin and eye). Provided that the overall exposure remains below international guidelines, no consequences for public health are anticipated.



# What are the international exposure guidelines?



Two international bodies produce exposure guidelines on electromagnetic fields. Many countries currently adhere to the guidelines recommended by:

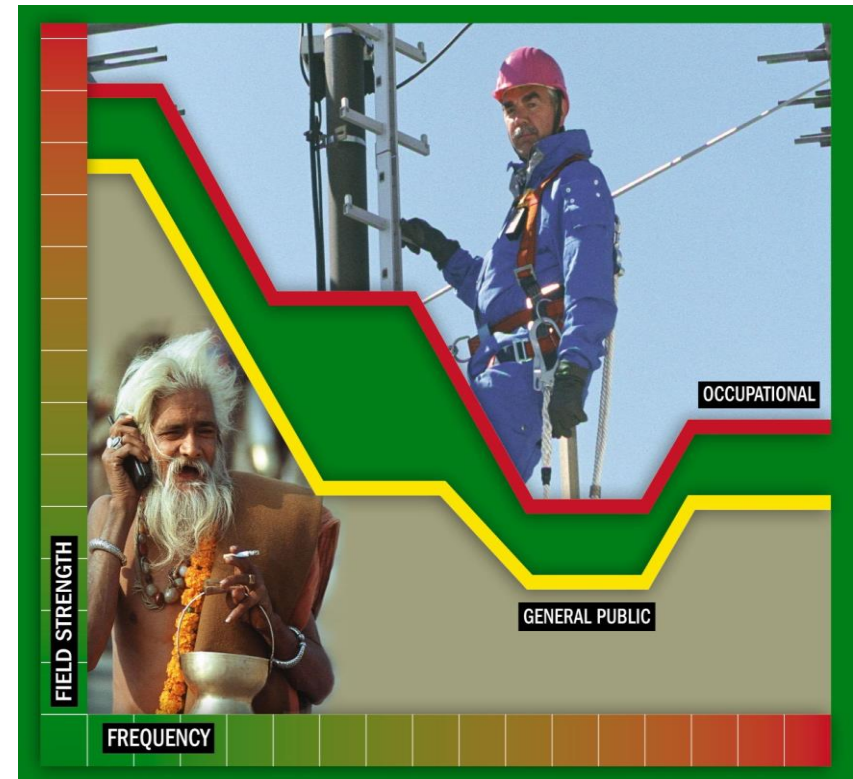
The International Commission on Non-Ionizing Radiation Protection and,

The Institute of Electrical and Electronics Engineers, through the International Committee on Electromagnetic Safety

These guidelines are not technology-specific. They cover radiofrequencies up to 300 GHz, including the frequencies under discussion for 5G.

# Exposure guidelines

- Exposure guidelines are frequency dependent, and are independent of any specific technology
- A number of countries have legislation over the whole EMF spectrum, which therefore covers the frequencies to be used by **5G**
- Countries that have precautionary limits (well below thermal thresholds) may face difficulty deploying **5G**



# What is WHO doing?

WHO is conducting a health risk assessment from exposure to radiofrequencies, covering the entire radiofrequency range, including 5G, to be published by 2022.

WHO will review scientific evidence related to potential health risks from 5G exposure as the new technology is deployed, and as more public health-related data become available.

WHO established the International Electromagnetic Fields (EMF) Project in 1996. The project investigates the health impact of exposure to electric and magnetic fields in the frequency range 0-300 GHz and advises national authorities on EMF radiation protection.

WHO advocates for further research into the possible long-term health impacts of all aspects of mobile-telecommunications. The Organization identifies and promotes related research priorities. It also develops public information materials and promotes dialogue among scientists, governments, and the public to increase understanding around health and mobile communications.

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.

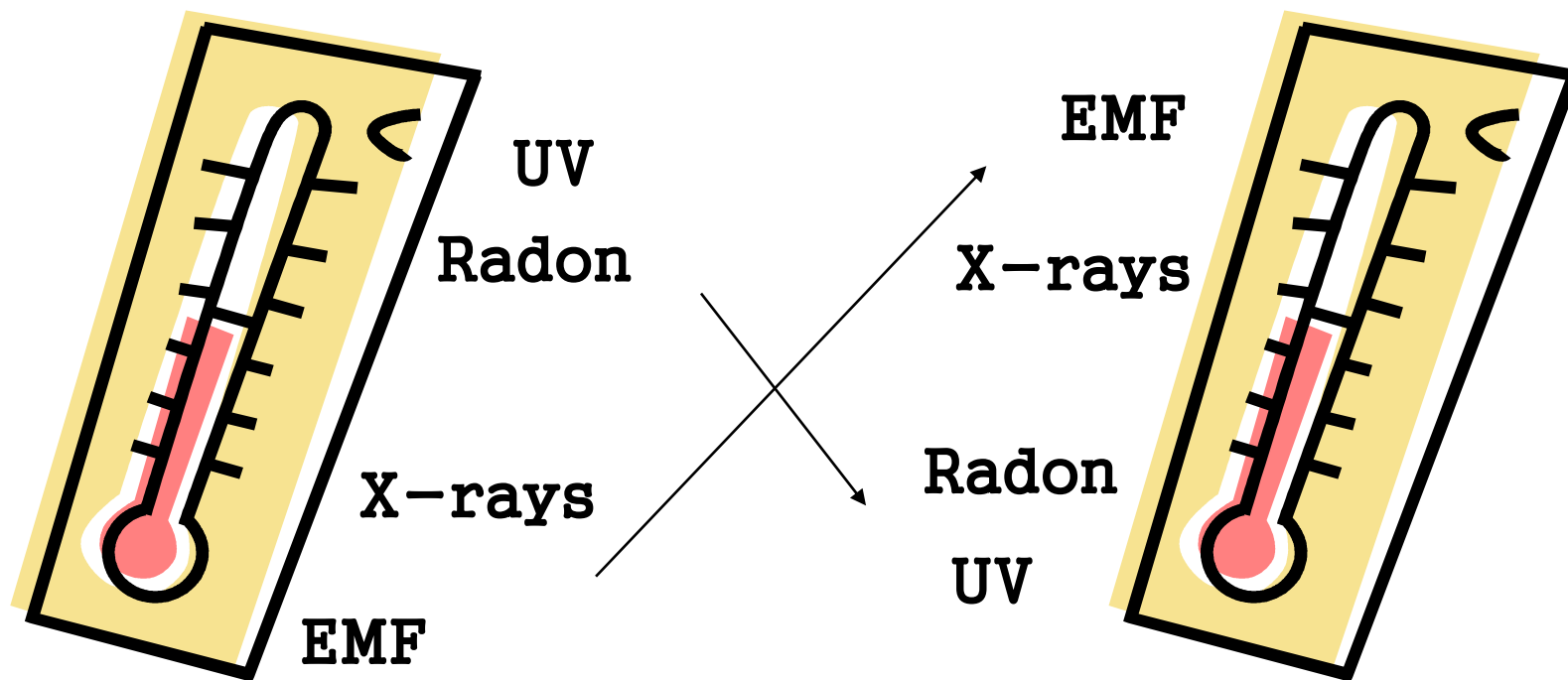
“The higher the frequency, the more dangerous,” according to *Radiation*...

# Radiation

## Risk Communication

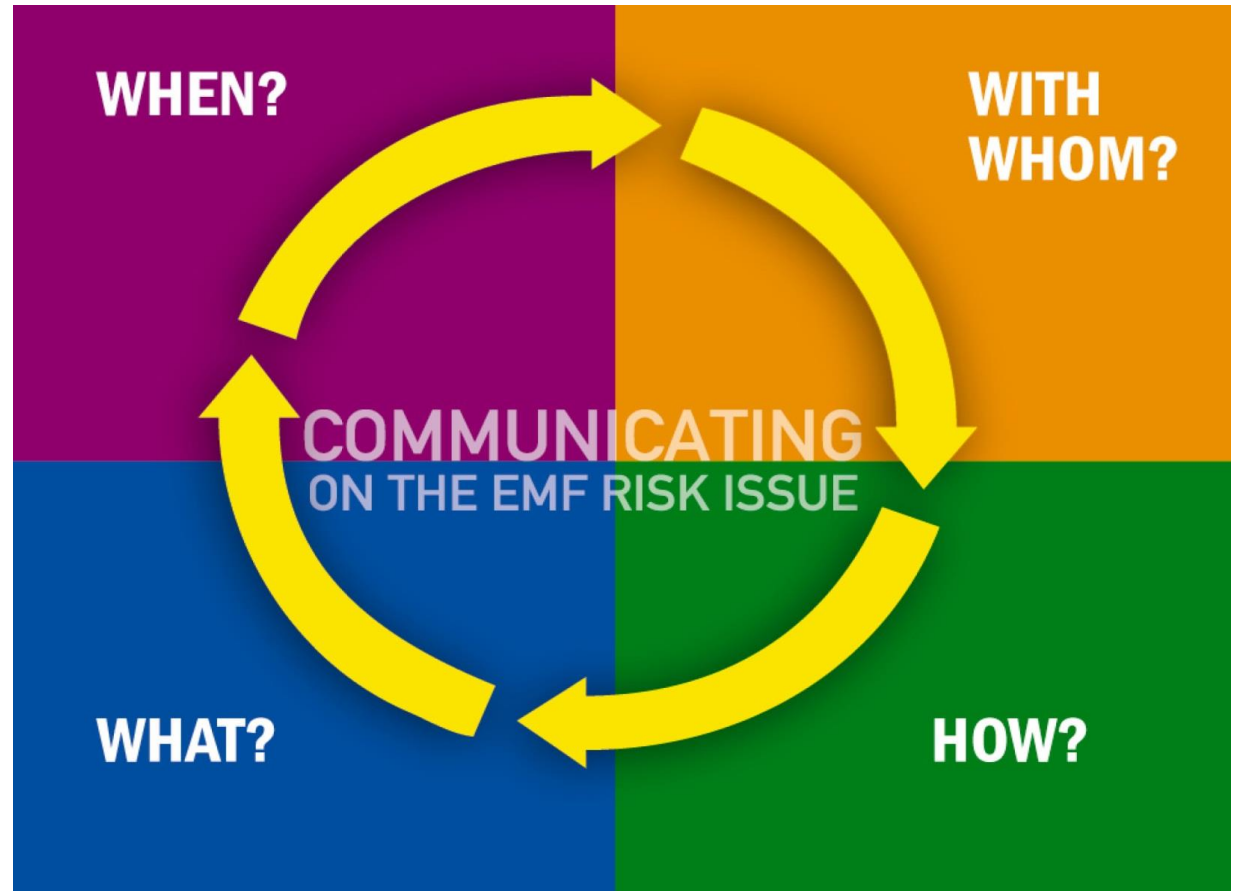
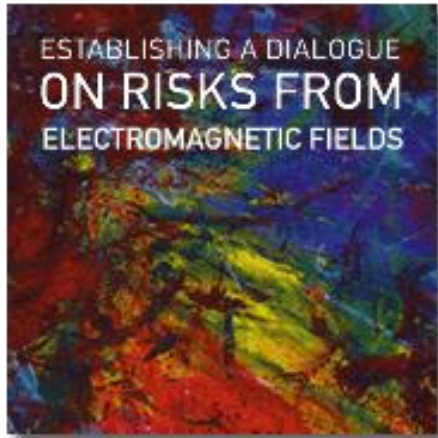
### *Public Health*

### *Public Concern*





# Managing EMF Risk Communication





# 30 June - Social Media Day

## *#takecarebeforeyoushare*



**“PAUSE: Take Care Before You Share”** campaign is a UN-wide effort to counter the spread of misinformation and to help establish a new set of norms for sharing content on social media.

Just as COVID-19 poses a threat to everyone, the spread of misinformation also plagues people across countries and social media platforms, and even in closed chat groups like whatsapp. The UN is calling on civil society and individuals to take five seconds to PAUSE and contemplate before sharing COVID-19 related information that could be harmful, inaccurate, and misleading.

**Before you share online,  
consider the 5 W's**

**WHO made it?**

**WHAT is the source of  
information?**

**WHERE did it come from?**

**WHY are you sharing this?**

**WHEN was it published?**

# 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, ...)

# Conclusions

- 5G represents a gradual extension of the wireless spectrum, and knowledge from current and past wireless technologies is applicable
- The use of the mm-wave is not new, but 5G networks will bring greater exposure to the public (and workers)
- Further research into possible effects on skin and eye at mm-wave frequencies is warranted
  
- 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