

ITU Regional Forum for Europe on 5G Strategies,
policies and implementation

Session 5: "*5G implementation: EMF and other challenges*"



Radiofrequency Electromagnetic Fields and Health

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POWER LINES



TRAINS



RADAR

0 Hz 10² 10⁴ 10⁶ 10⁸ 10¹⁰ 10¹²

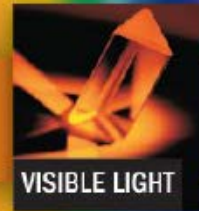
FREQUENCY (Hz OR CYCLES PER SECOND)



PERSONAL COMPUTER



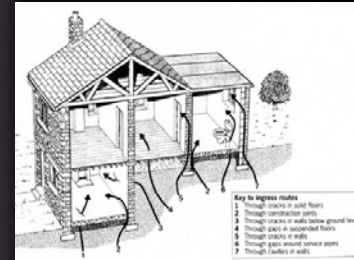
CELL PHONE



VISIBLE LIGHT



X-RAY



Applications using radiofrequency fields (100 kHz – 300 GHz)



Telecommunications

Wi-Fi



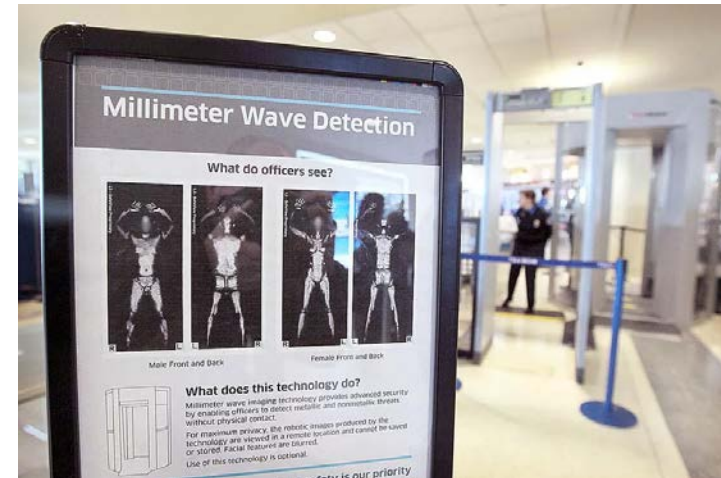
Navigation/Radar



Broadcasting



Commercial



Residential sources

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

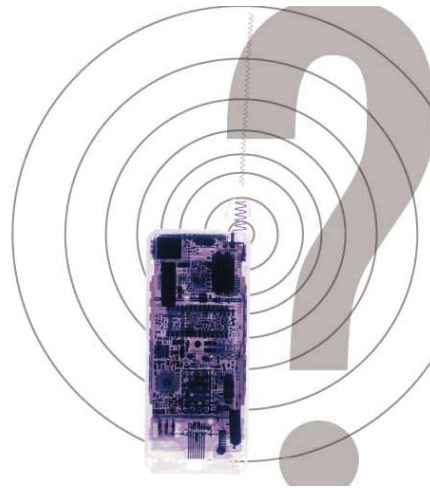
300 MHz

10 GHz

Frequency

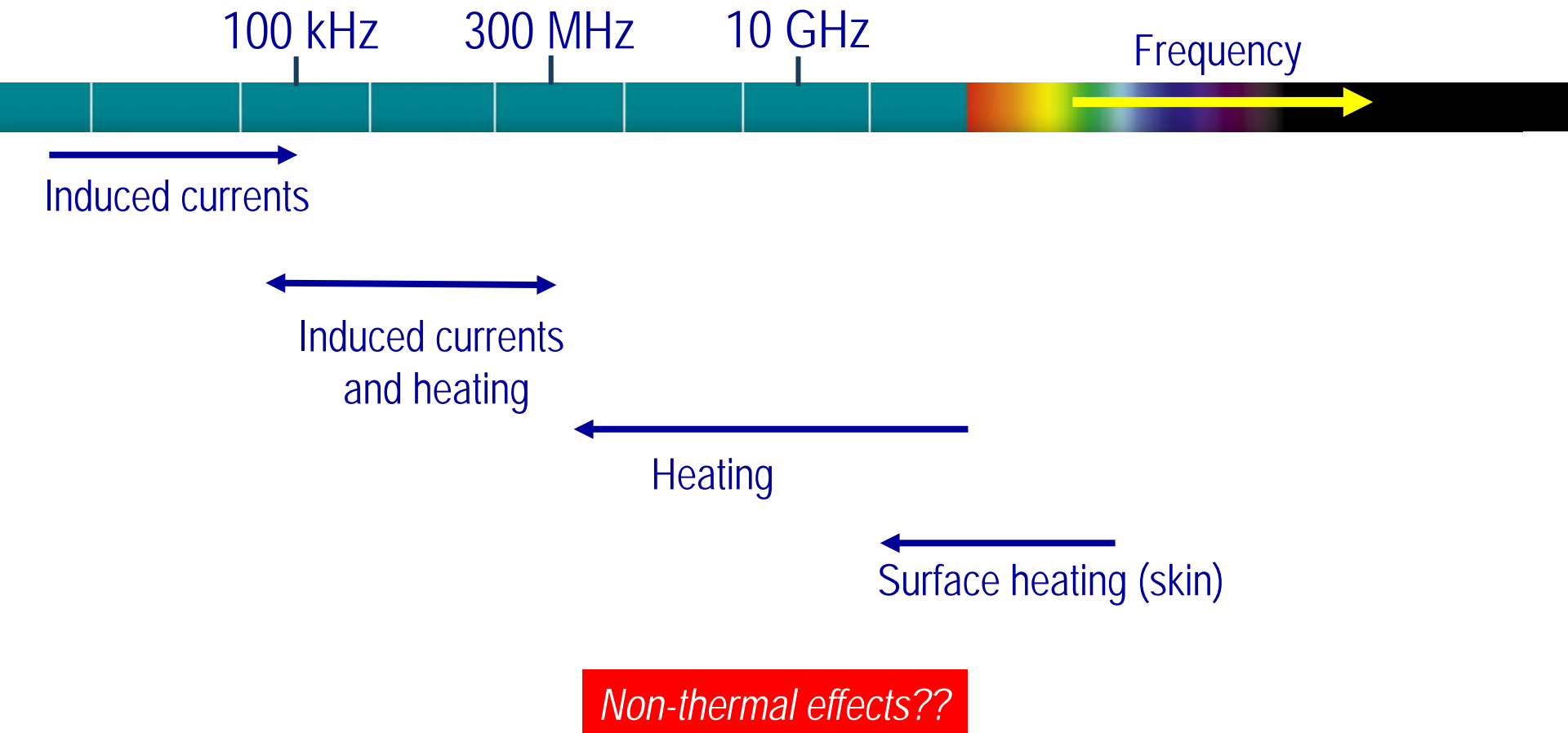


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What do we know?

Mechanisms of interaction



What are the international exposure guidelines?



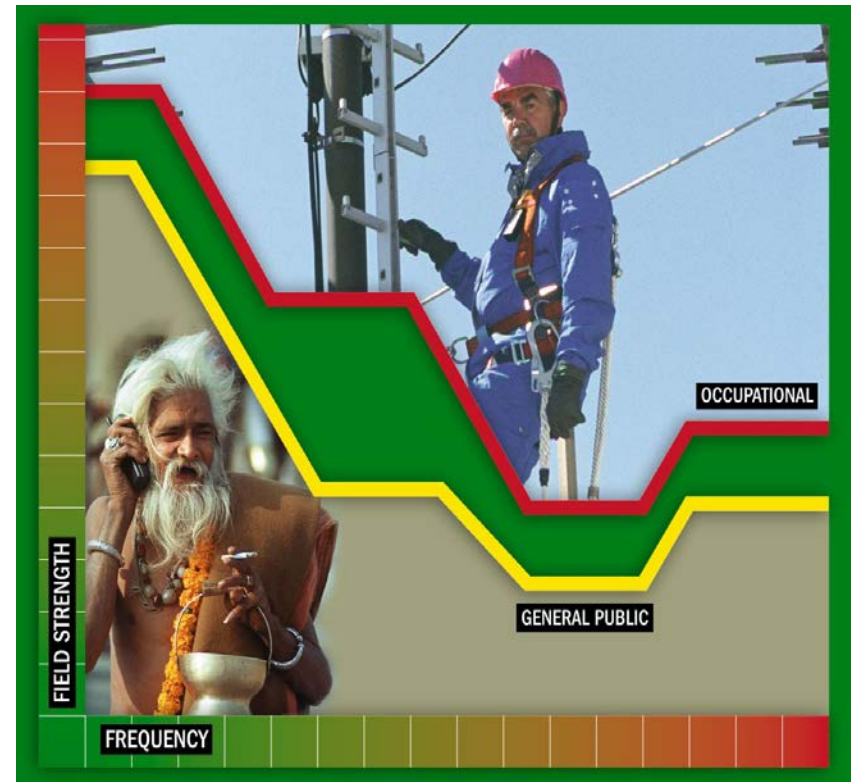
Two international bodies produce exposure guidelines on electromagnetic fields. Many countries currently adhere to the guidelines recommended by:

- 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 to be used by 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



What is WHO doing?

WHO established the International Electromagnetic Fields (EMF) Project in 1996.

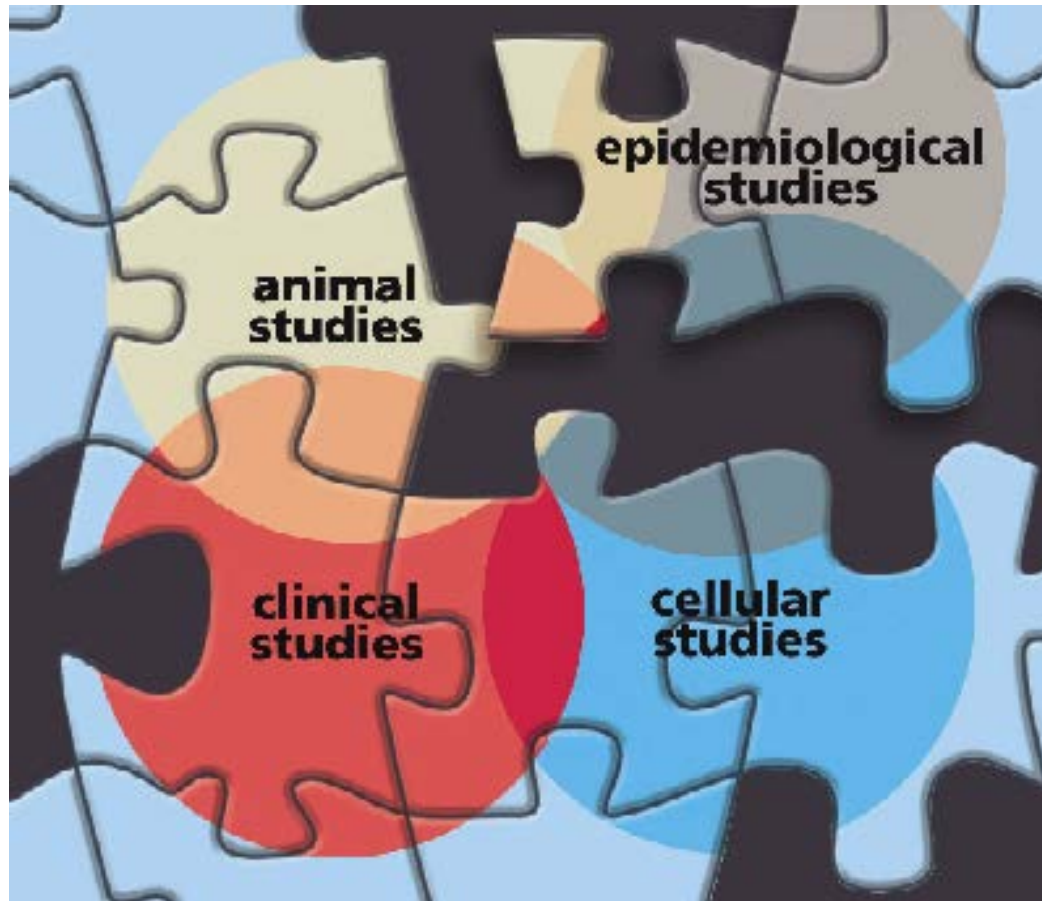
The project **investigates** the health impact of exposure to electric and magnetic fields in the frequency range 0-300 GHz and **advises** national authorities on EMF radiation protection.

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.

Evaluating the health risks

Review of research



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

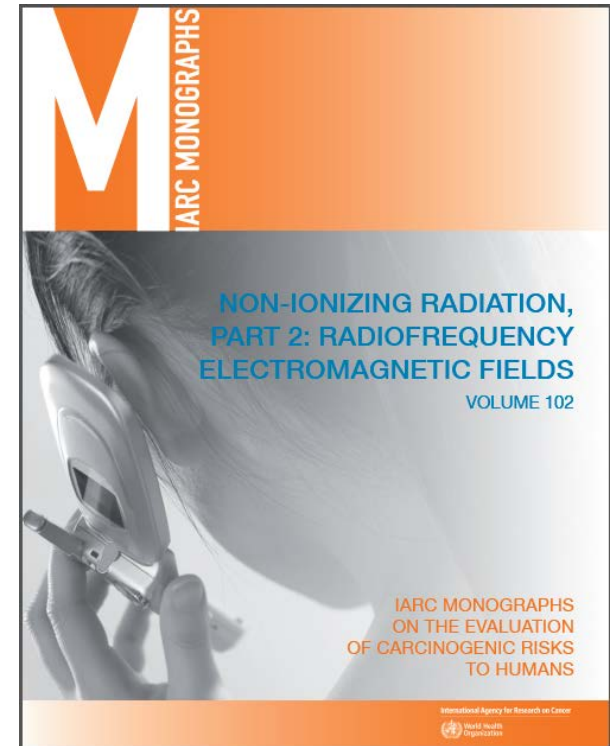
IARC Evaluation of Radiofrequency Fields Volume 102 (2013)



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



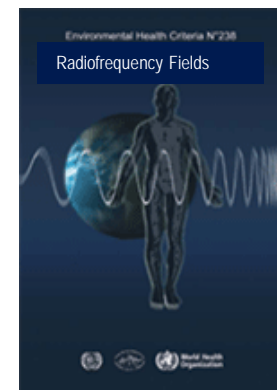
Radio Frequency fields

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.

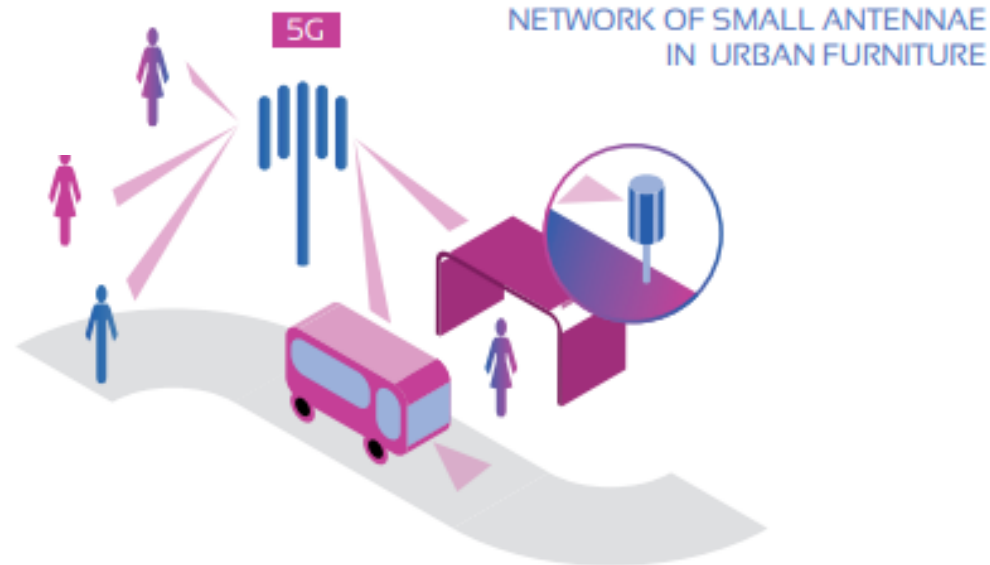
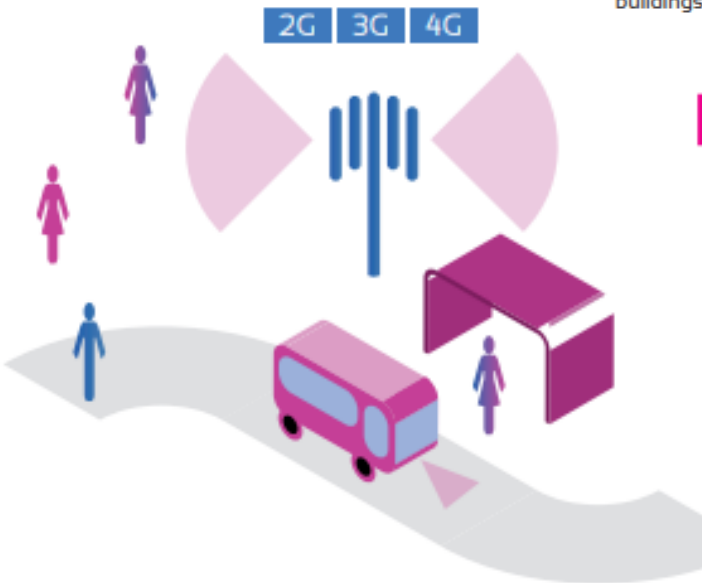
Through this Call, WHO invites eligible teams to indicate their interest in undertaking a systematic review on one (or more) of the following topics:

- ↓ 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 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.

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?



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.

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*

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



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