Radiofrequency Electromagnetic Fields and Health

Dr Emilie van Deventer
Radiation and Health Unit
Department of Environment, Climate Change and Health
Geneva, Switzerland

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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)
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
- CLIMATE CHANGE
- BUILT ENVIRONMENTS including housing and roads
- AGRICULTURAL PRACTICES including pesticide-use, waste-water reuse
- OCCUPATIONAL RISKS
- COMMUNITY NOISE
- RADIATION ultraviolet and ionizing
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
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• **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)

- Navigation/Radar
- Broadcasting
- Telecommunications
- Commercial
- Residential sources
Wireless technologies

1G
Voice
NMT, AMPS, TACS
2.4 Kbps

2G
Voice and text
GSM, IS-95, D-AMPS
64 Kbps

3G
Mobile data
W-CDMA, UMTS, CDMA2000 EV-DO
384 Kbps

4G
Mobile broadband
LTE
100 Mbps
1 Gbps
Gigabit
LTE

5G
Anything, Anywhere, Anytime, Unlimited
IMT 2020
10 Gbps
Multi-Gigabits
5G
NEW 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

# INTELLIGENT CITIES
Energy management
Public security
Connected territories

# TOMORROW INDUSTRY
Robotics
Remote piloting
Automation

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

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.

5G frequency spectrum

NEW FREQUENCY BANDS

- Bands already attributed to mobile that could be reused for 5G
- "Low" frequencies with wide coverage including inside buildings
- 5G Bands identified in Europe
- "High frequencies" with high capacity, limited indoor coverage
- Bands being studied

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

≠
What do we know?
Mechanisms of interaction

Induced currents
Induced currents and heating
Heating
Surface heating (skin)

Non-thermal effects??

Frequency
100 kHz  300 MHz  10 GHz
Evaluating the health risks
Review of research

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?

2. Exposure assessment
What exposures are likely to occur, and what is the resulting dose to humans?

3. Dose-response relationship
What are the health problems at different exposure levels?

4. Risk characterization
What is the health risk in the exposed population?
Problem Formulation

Health Risk Assessment

Hazard Identification
Review key research to identify any potential health problems that an agent can cause

Exposure Assessment
Determine the amount, duration and pattern of exposure to the agent

Exposure-Response Assessment
Estimate how much of the agent it would take to cause varying degrees of health effects that could lead to illnesses

Risk Characterization
Assess the risk for the agent to cause cancer or other illnesses in the general population

International Agency for Research on Cancer (IARC)
Centre International de Recherche sur le Cancer (CIRC)

RF fields classified as "possibly carcinogenic to humans" (Group 2B)
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All studied outcomes

Health Risk Assessment (cont'd)
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 adverse health outcomes, WHO conducted a broad international survey in 2018. Three major topics were identified for which WHO will now commission systematic reviews and 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, …)
WHO and 5G

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

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<td>What are the main differences between 5G and previous technologies?</td>
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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
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

• To date, WHO has not developed EMF exposure guidelines, and does not endorse guidelines developed by external entities
Radiation Risk Communication

Public Health

- UV
- Radon
- X-rays
- EMF

Public Concern

- EMF
- X-rays
- Radon
- UV
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 age.

Stop Smart Meters!

Fighting for health, privacy, and safety
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 Rensselaer County Public Schools in Florida received an alarming report. Like many other school districts at the time, Rensselaer was considering laptops and wireless networks for its classrooms and 20,000 students. Were there any health risks?

The district asked Bill R. Curry, a consultant and physician, 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 (Gray 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 frequency reached the 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 cause 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, cordless phones and wireless local networks rose. To an alarming degree, anxiety over 5G technology was traced to a single scientist and a single 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. The chart, they noted, omitted critical data.

Curry's research, they claimed, was not based on actual measurements. It was a mathematical extrapolation of computer simulations, not an empirical study. The chart was a misleading visualization of a complex issue.

And so the chart lived on, even as the reality of 5G became more clear. In recent years, the frequency of cellphone use has increased, and the rates of cancer have not risen. Similarly, the incidence of brain tumors has remained stable.

"The rapid increase in the use of cellphones increases the risk of cancer, but not in a statistically significant way," said Dr. Carpenter.

As the frequencies of wireless devices continued to rise, an associated risk of brain cancer was repeatedly cited, even though the data did not support the claim.

"The higher the frequency, the more dangerous," according to Carpenter. It is not a scientifically established fact.
Managing EMF Risk Communication

Information provision on 5G

National examples

5G:

The next generation (5G) of mobile phones will be available from 2020. Self-driving cars, video-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.

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.
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 EMF).

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 EMF. The Standard is consistent with international best practice and is reviewed regularly as new research emerges.

For more information visit arpansa.gov.au
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

#Coronavirus  #COVID19