WHO Frequently Asked Questions & ITU EMF GUIDE

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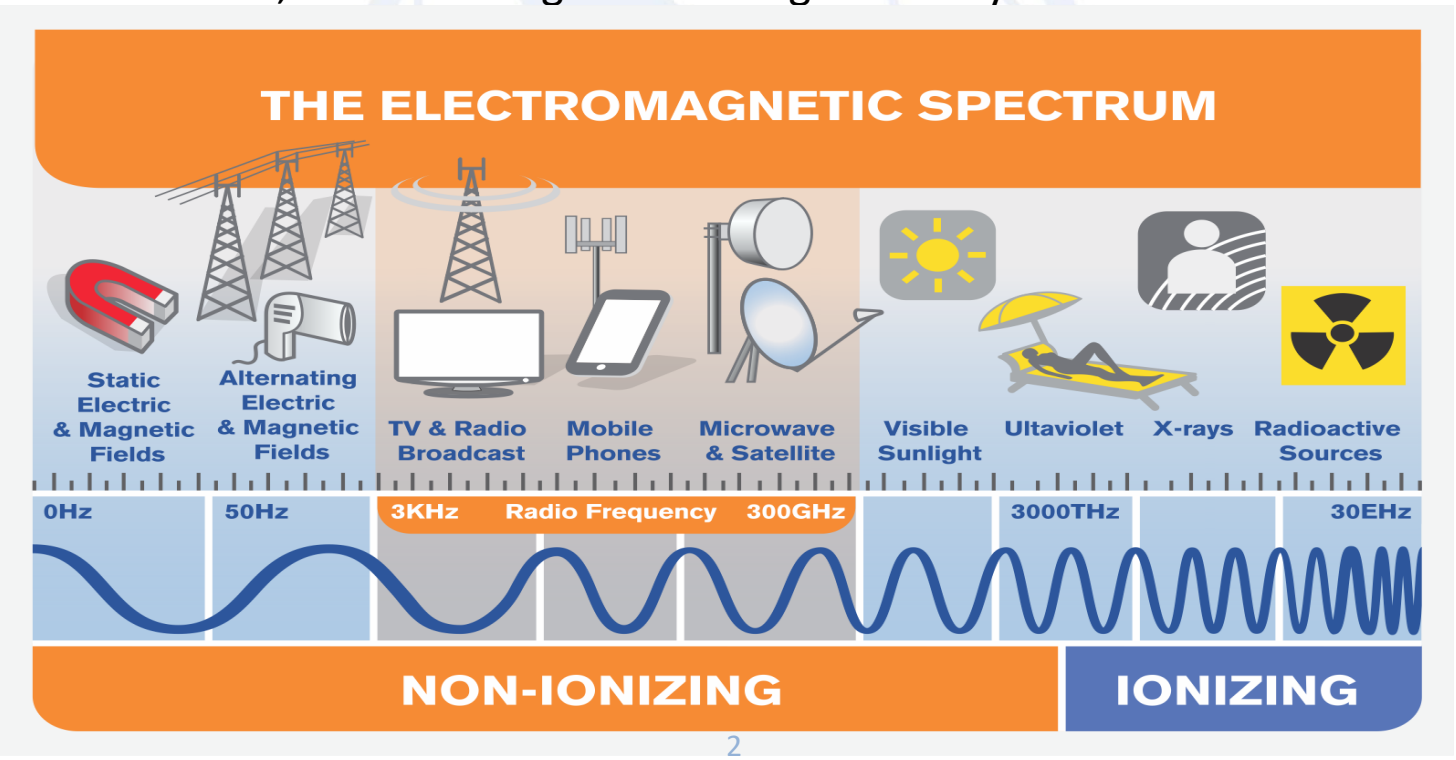
What is electromagnetic spectrum?

Electromagnetic fields have been around in different forms since the birth of the universe. They differ from each other by frequency and visible light is its most familiar form.

Electric and magnetic fields are part of the electromagnetic spectrum which extends from static electric and magnetic fields, through radio frequency (RF), infrared radiation, and visible light to X and gamma-rays.



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What is an electromagnetic field (EMF)?

An electromagnetic field consists of waves of electric and magnetic energy moving together through space. Often the term "electromagnetic field" or EMF is used to indicate the presence of electromagnetic radiation.

What is a radio frequency (RF) electromagnetic field?

Part of the electromagnetic spectrum extending from 3 kHz frequency to 3000 GHz is referred as radio frequency (RF). Television and radio transmitters (including base stations) and microwaves, mobile telephones, and radars produce radio frequency fields. These fields are used to transmit information and form the basis of telecommunications as well as radio and television broadcasting all over the world. Many home devices also transmit EMF at radio frequencies such as cordless phones, baby monitors and radio-controlled toys.

What is ionizing radiation?

Electromagnetic radiation at frequencies above the UV band are classified as "ionizing radiation", because they have enough energy to effect changes in the atoms, by liberating electrons (ionizing) and thus altering their chemical bonds. X-rays and gamma rays are common forms of ionizing radiation.

Ionizing radiation occurs at frequencies above 2900 THz (2900×10^{12} Hz). This corresponds to a wavelength of about 103.4 nm, which lies near the lower wavelength-edge of the Ultraviolet (UV) spectrum.

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What is non-ionizing radiation?

Electromagnetic radiation at frequencies below the UV band are classified as "non-ionizing radiation" because they lack the energy to liberate electrons, i.e. ionize or effect changes in atomic structure. Radio frequency fields are non-ionizing radiation.

Wireless communication technology has become indispensable part of the modern society. The use of mobile phones, tablets and wireless devices have become basic communication tools of everyday life for billions of people around the world, and also common for medical applications. Base stations and telecommunications towers are continuously being erected to provide good quality wireless communications.

Together with the introduction of wireless communication technologies, there has been some public concern about the potential health risks associated with wireless communications including the use of mobile phones and living near base stations.

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Electromagnetic fields (EMFs) of all frequencies represent one of the most common and fastest growing environmental influences. As part of its charter to protect public health and in response to public concern, the WHO established the International EMF Project in 1996. The purpose of the EMF Project is to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz.

Information on the WHO EMF project is available at **http://www.who.int/peh-emf/about/en/**.

In terms of EMF and health the WHO notes that:

"All reviews conducted so far have indicated that exposures below the limits recommended in the International Commission for Non-Ionizing Radiation Protection (ICNIRP) 1998 EMF guidelines, covering the full frequency range from 0-300 GHz, do not produce any known adverse health effect. However, there are gaps in knowledge still needing to be filled before better health risk assessments can be made."

Source:
WHO EMF Research

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Mobile phones and health

Regarding mobile phones and health, the WHO notes that:

"Many studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use."

"While an increased risk of brain tumors from the use of mobile phones is not established, the increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of mobile phone use and brain cancer risk. In particular, with the recent popularity of mobile phone use among younger people, and therefore a potentially longer lifetime of exposure, WHO has promoted further research on this group and is currently assessing the health impact of RF fields on all studied endpoints."

Source:

1. **WHO Fact Sheet 193 June 2011**
2. **WHO Online Q&A September 2013**

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Base stations and health

With respect to base stations and health, the WHO notes that:

"Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects."

"Studies to date provide no indication that environmental exposure to RF fields, such as from base stations, increases the risk of cancer or any other disease."

Source:

1. **WHO Online Q&A September 2013**
2. **WHO Backgrounder 2006**

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Human exposure guidelines

In terms of human exposure guidelines, the WHO notes that:

"A number of national and international organizations have formulated guidelines establishing limits for occupational and residential EMF exposure. The exposure limits for EMF fields developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) - a non-governmental organization formally recognised by the WHO, were developed following reviews of all the peer-reviewed scientific literature, including thermal and non-thermal effects. The standards are based on evaluations of biological effects that have been established to have health consequences."

Source:
WHO EMF Standards and Guidelines

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Research on EMF and health

Extensive research has been conducted into possible health effects of exposure to many parts of the electromagnetic spectrum.

Biological effect versus adverse health effect

A biological effect occurs when exposure to electromagnetic fields causes some noticeable or detectable physiological change in a biological system which is not necessarily hazardous. An adverse health effect occurs when the biological effect is outside the normal range for the body to compensate and which is detrimental to health or well-being.

What are the effects of RF EMF?

Exposure to RF EMF at high levels can cause the heating of tissues that leads to an increase in the body temperature. This is known as the thermal effect. Although the body has its effective ways of regulating its temperature, nevertheless, if the RF exposures are too high, the body may no longer be able to cope.

At frequencies above 10 MHz, the first scientifically established effect to occur is heating. At frequencies below 10 MHz, the first effect to be experienced is non-thermal nerve stimulation (a tingling sensation).

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International Agency for Research on Cancer

IARC classification of RF EMF

In May 2011 IARC classified radio frequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer associated with wireless phone use.

The **IARC website** lists 285 agents classified as group 2B including RF fields, coffee, gasoline engine exhaust, pickled vegetables, ELF magnetic fields and styrene.

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The IARC provides the following summary of the classification:

"The evidence was reviewed critically, and overall evaluated as being limited among users of wireless telephones for glioma and acoustic neuroma, and inadequate to draw conclusions for other types of cancers. The evidence from the occupational and environmental exposures mentioned above was similarly judged inadequate."

"Limited evidence of carcinogenicity means a positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence."

"Inadequate evidence of carcinogenicity means the available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between exposure and cancer, or no data on cancer in humans are available."

"Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long- term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting."

Source:

IARC press release 31st May 2011

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Summary of the IARC classification of RF EMF

The WHO has provided the following summary of the IARC classification of radio frequency electromagnetic fields:

"The International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), a category used when a causal association is considered credible, but when chance, bias or confounding cannot be ruled out with reasonable confidence."

Source:

WHO Fact sheet 193 June 2011

In terms of what the IARC 2B classification means, the WHO summarises this as:

"Possibly carcinogenic to humans is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals."

Source:

WHO handbook "**Establishing a dialogue on risk from electromagnetic fields.**"

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IARC World Cancer Report 2014

In 2014, IARC published the World Cancer Report that says the most significant causes of all head and neck cancers are tobacco use and alcohol consumption….80% of such cancers. Brain tumors account for less than 2%.

In terms of mobile phones and cancer, and environmental exposures from transmitters the World Cancer Report 2014 says:

"No consistent association has been found between use of mobile (cell) phones and brain tumors"

"Therapeutic ionizing radiation is the only proven cause of brain cancer. The use of mobile phones remains under investigation"

"Associations between heavy use of mobile phones and certain brain cancers have been observed, but causal interpretation is controversial; more data are needed, particularly on longer-term use of mobile phones."

"With regard to environmental exposures from transmitters, including television, radio, and military transmissions as well as mobile phone networks, the evidence is inadequate due to lack of high-quality studies with accurate individual exposure assessment,"

Source:

IARC World Cancer Report 2014

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Mobile base station power

Overall mobile phone base stations operate at low power. The power from a mobile phone base station will vary depending on the number of mobile phone calls and amount of data traffic being carried. In addition to the data and mobile phone calls, a pilot signal is continuously transmitted from the base station so that nearby mobile phones can detect the network.

Mobile phone power

Mobile phones use low power transmitters that are less than two watts peak. Mobile phones are designed to automatically transmit at the lowest possible power to maintain a quality connection. This is a feature known as adaptive power control.

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What is specific absorption rate (SAR)?

Specific absorption rate (SAR) is a measure of the amount of RF energy that is absorbed by the tissues in the human body and expressed in watts per kg (W/kg). This measurement is used to determine whether a mobile phone complies with the safety standards or guidelines.

How SAR varies.

The SAR from a mobile phone varies considerably during use due to adaptive power control and the connection back to the mobile network. A maximum SAR value does not provide enough information about the amount of RF exposure under typical usage conditions to reliably compare individual cell phone models. The level of exposure depends on the distance between the person and the mobile and the amount of RF power the mobile transmits.

Mobile devices will attempt to use the minimum amount of energy to provide a reliable service quality while at the same time preserve battery life, actual exposure varies continually depending on a range of factors:

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The distance between the person and the mobile device

RF fields are much weaker even a short distance from a mobile. Keeping the mobile away from the body by using an earpiece or loudspeaker function will significantly reduce exposure.

The distance from the base station

RF EMF from a mobile phone will vary its power level depending on its proximity to a base station using automatic power control. The closer it is to a base station, the less power is required - the further away it is, the more power is required (up to the phones maximum SAR).

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Making a voice call from a mobile phone could lead to greater exposure than texts, emails, pictures, web, TV and downloads. This is because voice calls are generally made with the mobile phone next to the head, while it is held away from the body when sending texts and emails and watching TV. Calls may also take longer than sending texts and emails, again increasing exposure. The time taken to write a text or email or reviewing information already stored on your mobile phone will not result in any significant exposure.

Exposure is related to actual communications with the network, such as during the sending of a message or continuously during a voice call. These higher levels of exposure as a result of a voice call are still less than the ICNIRP guidelines because all phones must comply with international safety standards.

Mobile phones are also designed to use the lowest possible power to connect to the nearest base station and automatically adjust the power depending on the environment.

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What is the typical power of a mobile?

The typical output power of a mobile phone ranges from 10 to 100 milli-watts (mW) which considers the operation of adaptive power control. Note in rural areas typical powers maybe higher.

References:

1. **Output power distributions of terminals in a 3G mobile communication network.**
2. **Determinants of mobile phone output power in a multinational study: implications for exposure assessment.**

How can I reduce exposure from my mobile?

Mobile phones are designed to operate automatically at the lowest possible power minimizing exposure. However there are some additional steps as outlined by the WHO you can take to further reduce exposure.

The WHO notes that:

"In addition to using 'hands-free' devices, which keep mobile phones away from the head and body during phone calls, exposure is also reduced by limiting the number and length of calls. Using the phone in areas of good reception also decreases exposure as it allows the phone to transmit at reduced power".

Source:

WHO Fact Sheet No.193 - Electromagnetic fields and public health: mobile phones.

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Do mobile phone shields reduce exposure?

No. Mobile phones are designed to use the lowest possible power to connect to the nearest base station and automatically adjust the power depending on the environment.

If a shield or other device is placed on a mobile phone to reduce exposure, the shield will effectively block part of the radio signal (or reception), and the phone will automatically adjust the power to compensate for any loss of signal.

The WHO notes that:

"The use of commercial devices for reducing radiofrequency field exposure has not been shown to be effective."

Source:
WHO Fact Sheet No.193 - Electromagnetic fields and public health: mobile phones.

Do mobiles emit less EMF when the signal display has full bars?

Yes. Mobile phones operate at the lowest possible power in areas of good reception.

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Do mobiles radiate less EMF when close to a base station?

Yes. Mobile phones use the lowest possible power when in a good reception or coverage area. This is typically when close to a mobile base station as the phone only has to transmit over a short distance back to the nearest base station.

Mobile networks automatically adjust the mobile phone and base station power required to maintain a connection. So mobile phones produce the lowest EMF when in a good coverage area and close to a base station.

Does texting emit less EMF compared to a voice call?

Yes. An SMS message is sent using a very short data transmission and where the phone is physically away from the head.

In terms of exposure levels the WHO notes that:

"A person using a mobile phone 30-40 cm away from their body - for example when text messaging, accessing the Internet, or using a "hands free" device - will therefore have a much lower exposure to radiofrequency fields than someone holding the handset against their head."

Source:

WHO Fact Sheet No.193 - Electromagnetic fields and public health: mobile phones.

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Are we at a high risk of EMF exposure when using mobile phones inside high speed transportation?

If the mobile phone reception is poorer the EMF transmissions of a handset increases to connect to a base station. Some high-speed trains, busses and aero planes have inbuilt mobile repeater cells that provide good coverage inside and mobile phones will operate at a lower SAR. Where the high-speed transport is away from good mobile phone reception, the handset power and exposure will increase during calls.

Is using a mobile phone in the car or at home safer because these constitute a barrier to radiation?

If the mobile network reception is lower inside a car or house, a mobile phone may increase the transmitter power to maintain a quality connection. Mobile phones continuously adjust the transmitter power depending on reception quality and are designed to operate at the lowest power possible.

Mobile phones are tested for compliance to the human exposure standards at their highest possible power level. Variations in transmitter power do not mean that there are variations in safety.

An external car antenna can be used to improve the mobile phone reception and reduce the exposure levels inside a vehicle.

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Are children more vulnerable to the EMF from mobile phones than adults?

This is a very important question and the focus of ongoing research.

The WHO notes that studies into long term health effects are ongoing and to date no causal relationship or health effect has been established for children.

Young children can absorb more EMF primarily due to the physical proximity of a mobile phone when making a call and the relative smaller head size of children.

A number of health agencies recommend children restrict mobile phone use. Children can use a headset, hands-free, speaker phone or SMS options to reduce exposure.

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What are the EMF levels around base stations?

EMF levels in the community and environment from mobile phone base stations are typically low and like the background levels from other radio transmissions like TV and radio broadcast. Base station antennas are usually mounted on top of structures like towers, poles and buildings.

The World Health Organization monitors the scientific research on EMF including studies on EMF levels around base stations.

For EMF levels around base stations and in the environment, the WHO notes that:

"Even today, the phone towers themselves add little to our total exposure, as signal strengths in places of public access are normally similar to or lower than those from distant radio and TV stations."

"Many surveys have demonstrated that exposure to electromagnetic field levels in the living environment is extremely low."

"Recent surveys have shown that RF exposures from BS range from 0.002% to 2% of the levels of international exposure guidelines, depending on a variety of factors such as the proximity to the antenna and the surrounding environment."

Source:

1. **WHO - Typical Exposure Levels in the Home and Environment**

2. **WHO Backgrounder May 2006 - Base stations and wireless technologies**

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Is it safe to live near a base station or locate base stations near schools or hospitals?

Yes. It is safe to live near a mobile phone base station as they operate at low power, produce low EMF exposure levels in public areas and are specifically designed for the environment they are located in.

The WHO notes that:

"Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects."

"Studies to date provide no indication that environmental exposure to RF fields, such as from base stations, increases the risk of cancer or any other disease."

Source:

1. **WHO Backgrounder May 2006 - Base stations and wireless technologies**
2. **WHO Online Q&A September 2013**

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In built-up urban and residential areas, base station antennas are typically located above building rooftops or at a enough distance from nearby buildings. Low powered base stations are often located inside apartment and city buildings to provide dedicated mobile coverage.

Higher powered base stations are located in rural and country areas to provide extended coverage and are usually mounted on taller structures or towers.

RF exposures from base stations typically range from 0.002% to 2% of the levels of international exposure guidelines, depending on a variety of factors such as the proximity to the antenna and the surrounding environment. This is lower or comparable to RF exposures from radio or television broadcast transmitters.

Base stations are designed and operated so that people are not exposed above the recommended limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Measurements of EMF by regulatory authorities in many countries indicate that exposure levels in public areas are typically below the ICNIRP Guideline.

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Do more base stations reduce EMF?

Yes. As a matter of fact, by increasing the number of base stations and locating them near where people use mobile phones reduces EMF levels. This is because the mobile phones only need to transmit over a short distance to the nearest base station using less power, and the network is also operating more efficiently only needing to communicate with nearby users.

Is it safe to locate base stations on hospitals?

Yes. Many hospitals have base stations located on the rooftop and dedicated in-building mobile systems to provide the best coverage inside the hospital. The in-building system means that mobile phones inside the hospital also operate at the lowest possible power.

Are there restricted areas in front of base station antennas?

Yes. Base station antennas typically have an area directly in front of the antenna where the radio frequency field level will exceed the human exposure limits recommended by ICNIRP. These restricted areas are typically not accessible to the public as the base station antennas are mounted well clear of public areas.

Mobile network operators need to ensure that restricted areas around base stations are incorporated into the site design.

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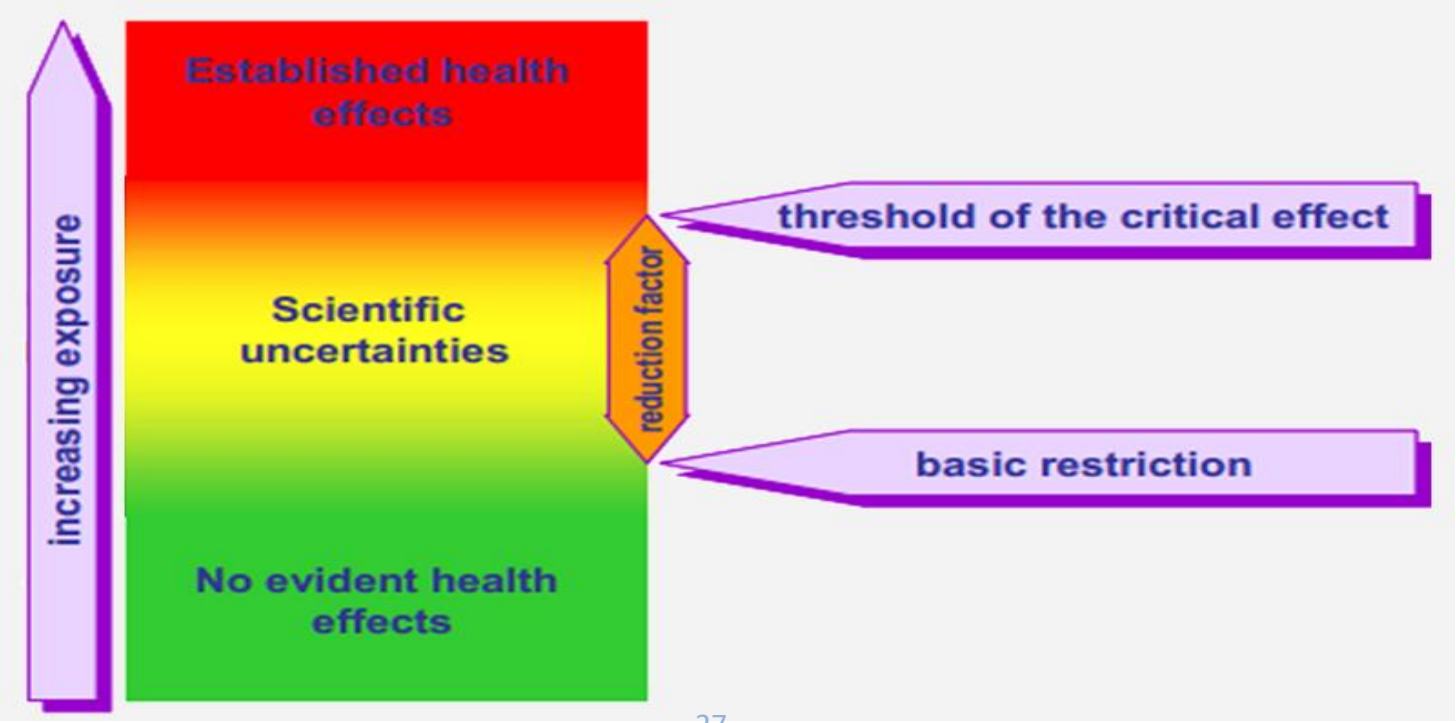
Is there a safety margin built into the standards?

Yes. A safety margin is built into the limits recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP applies a safety factor of 10 to derive EMF worker exposure limits, and a factor of 50 to obtain the guideline value for the general public.

The reduction factor is designed to account for any scientific uncertainties.



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Are children and pregnant women protected by the safety standard?

Yes. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) EMF exposure guidelines are based on careful analysis of the scientific literature and are designed to offer protection for all ages including children and pregnant women against identified health effects of EMF with a large in-built safety margin.

Are people with electronic implants protected by the safety standard?

Not in all cases. Electronic implants usually come with safety information on the risk of potential interference from electrical and electronic equipment including mobile phones and radio transmitters.

Specific radio frequency interference and immunity standards have been developed to provide protection against interference to electronic implants.

People with implants should consult their medical specialist on the risk of interference if they are concerned. The ICNIRP human exposure guidelines are not designed to protect against interference into electronic equipment.

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Is it possible to cook an egg or grains of corn using a mobile phone?

No. The EMF exposure produced by mobile phones is weak and cannot cook an egg or grains of corn. The videos posted on the Internet are made for advertising or entertainment purposes by hobbyists who create a montage by superimposing segments to alter reality or by some companies that market video clips via Bluetooth for commercial purposes.

Although theoretical calculations of the output from mobile phones confirm that these claims are false, several international research centres nevertheless, conducted the same experiment, under laboratory conditions, in order to reassure people, refute these rumours and remove the anxieties surrounding them.

Is the power output of a mobile phone enough to make the brain boil?

No. The maximum power output of mobile phones is 2 watts and, in most cases, much less than that (an average of 0.25 watts).The thermal effect of electromagnetic waves may cause a slight warming of the body, comparable to the warming that results from physical exercise or exposure to the sun's rays. But it cannot make the brain boil.

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Does use of a mobile phone attract lightning?

It is well known that electric charge-bearing clouds discharge their energy to Earth through the closest conductor to the ground, whether a lamppost, electricity pylon, tree, building or person. The probability of a person being struck by a thunderbolt is very small, particularly in places where there are buildings, poles, trees etc.

Can a mobile phone cause a gas station to catch fire?

No. There is no causal link between the EMF exposure produced by mobile phones and a gas station catching fire. According to information published by the UK-based Institute of Petroleum and a report by the Australian Transport Safety Bureau, there is no evidence to prove that a mobile phone has ever caused a gas station to catch fire.

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QUESTIONS, if any before Session Closure or even later

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