



# Mobile Communications and Health



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Mobile phones and other wireless technologies have become an integral part of everyday life. But does using a mobile phone regularly, or living near a base station, have any implications for our health?

# CONTENTS

<b>WHAT ARE RADIO SIGNALS?</b>	<b>2</b>
<b>WHAT ARE THE BIOLOGICAL EFFECTS AND HAZARDS?</b>	<b>2</b>
<b>WHAT DO THE EXPERTS SAY?</b>	<b>3</b>
<b>RESEARCH</b>	<b>4</b>
<b>WHAT ARE THE INTERNATIONAL EXPOSURE RECOMMENDATIONS?</b>	<b>4</b>
<b>ICNIRP GUIDELINES</b>	<b>4</b>
<b>HOW DO MOBILE PHONES WORK?</b>	<b>4</b>
<b>WHAT IS A BASE STATION?</b>	<b>5</b>
<b>ILLNESS CLUSTERS</b>	<b>5</b>
<b>MOBILE PHONES</b>	<b>6</b>
<b>HANDSFREE KITS AND SHIELDS</b>	<b>7</b>
<b>CHILDREN AND RADIO SIGNALS</b>	<b>7</b>
<b>FAQS AND MYTHS</b>	<b>8-9</b>



# What are radio signals?

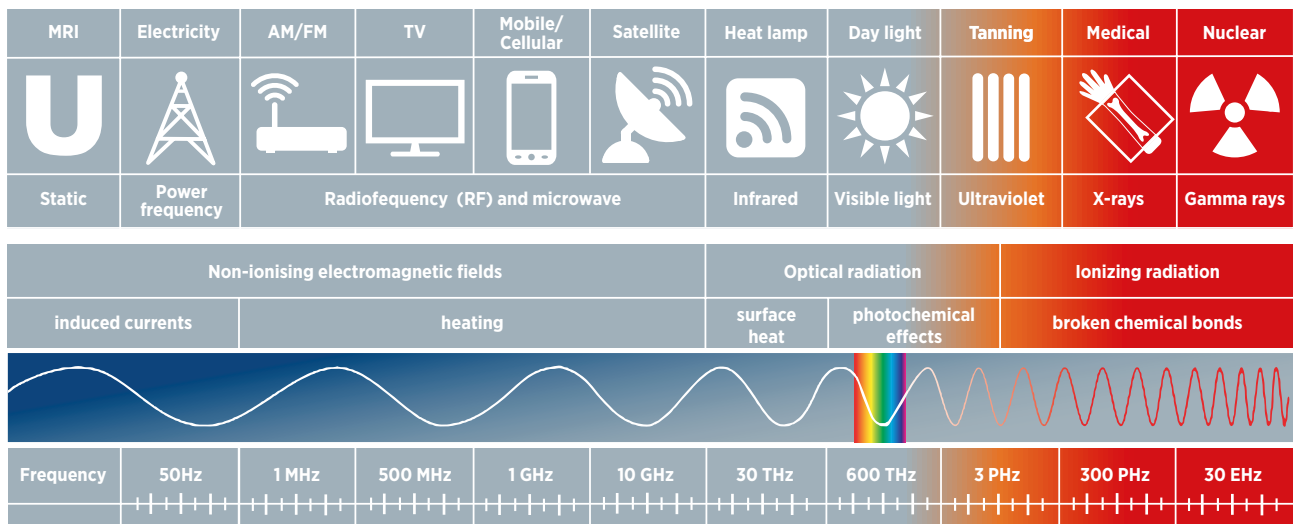
Radio signals are part of everyday life, emitted both by natural sources like the sun, the Earth and the ionosphere, and by artificial sources such as:

- mobile phone base stations
- broadcast towers
- radar facilities
- remote controls
- electrical and electronic equipment

Radio signals are a form of electromagnetic energy (or electromagnetic radiation – EMR), electric and magnetic fields moving together through space. Radio signals are non-ionising, which means that they cannot directly impart enough energy to a molecule to break or change chemical bonds. This is in contrast to ionising radiation, such as x-rays, which can strip electrons from atoms and molecules, producing changes that can lead to tissue damage and possibly cancer.

Figure 1

## The Electromagnetic Spectrum



# What are the biological effects and health hazards?

A biological effect occurs when a change can be measured in a biological system in response to a stimulus or change in the environment. However, a biological effect is not the same as a health hazard. A biological effect only becomes a health hazard when it damages the health of an individual.

It has been known for many years that exposure to sufficiently high levels of radio signals can heat biological tissue and potentially cause tissue damage if the human body cannot cope with the extra heat. Studies have consistently shown that the radio signals routinely encountered by the public are far below

the levels needed to produce significant heating and increased body temperature.

Much of the public concern relates to the possibility of health hazards from long term exposures at levels too low to produce measurable heating. There have been studies reporting biological effects but not health hazards at low levels. In many cases, the studies have not been subject to scientific peer review or the results have not been independently confirmed. The international consensus is that current limits are based on all the available scientific evidence, incorporate large safety factors and are highly protective of health.

# WHAT DO THE EXPERTS SAY?

“...Altogether it provides no or at most little indications for a risk for up to approximately 15 years of mobile phone use. No empirical data are available for longer use; however, cancer rates in Sweden and other countries do not show any increase that might be attributed to the massive mobile phone use that started in the beginning of this century...”

SSMs Independent Expert Group on Electromagnetic Fields (Sweden), 2016

“...The Committee feels that it is not possible to state that there is a proven association between long-term and frequent use of a mobile telephone and an increase in the risk of tumours in the brain and head and neck region in humans. Based on the strength of the evidence it can only be concluded that such an association cannot be excluded. The Committee considers it unlikely that exposure to radiofrequency fields, which is associated with the use of mobile telephones, causes cancer...”

Health Council of the Netherlands, 2016

“...it is the opinion of ICNIRP that the scientific literature published since the 1998 guidelines has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields.”

International Commission on Non-Ionising Radiation Protection (ICNIRP), 2009

“A large number of 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.”

World Health Organization (WHO), 2014

## Research

Extensive research has been conducted on the possible health effects of exposure to many types of radio signals. As of January 2012, there were over 1,800 publications related to mobile communications in the EMF-Portal ([www.emf-portal.de/](http://www.emf-portal.de/)) database.

Since 1990, more than 100 reports by expert panels and government agencies have examined the scientific evidence and their consensus is that there are no established health hazards from exposures to radio signals at levels below the 1998 guidelines of the International Commission on Non-Ionising Radiation Protection (ICNIRP). The World Health Organization (WHO) recommends adoption of the ICNIRP exposure guidelines.

In May 2011 radiofrequency (RF) electromagnetic fields were classified 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. The WHO has identified areas for continuing research to support future health risk assessments. Many research programmes have been guided by the WHO research recommendations and the WHO estimates that since 1997 over US\$ 200 million of funding has been allocated to such programmes.

## What are the international exposure recommendations?

In 1998, the ICNIRP, an independent scientific body recognised for its expertise by the WHO, issued guidelines for radio signal exposure that are applicable to mobile phones, base stations and other wireless devices.

The ICNIRP guidelines were developed following reviews of the scientific literature, including thermal and non-thermal effects, and are designed to provide protection against all established health hazards. The ICNIRP guidelines include substantial reduction factors. ICNIRP monitors new scientific findings to ensure that the recommendations are protective of health and confirmed the guidelines in 2009. A further review of the guidelines is underway by ICNIRP.

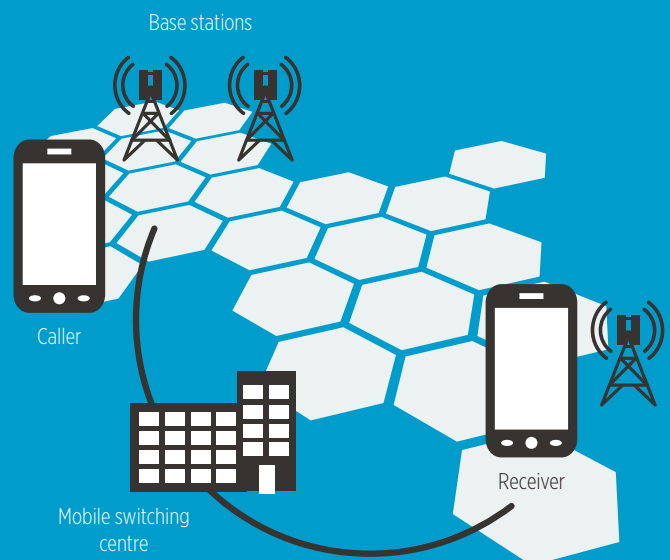
## ICNIRP Guidelines

The ICNIRP guidelines are recommended by the WHO, the International Telecommunications Union (ITU) and the European Commission and have been widely adopted in Africa, Asia, Europe, the Middle East and Latin America. Similar exposure standards are used in North America. Due to differences in scientific interpretation or in response to public concern some countries apply more restrictive standards. These measures provide no additional health protection and may lead to increased public concern.

## How do mobile phones work?

Mobile phone networks are divided into geographic areas called cells, each of which is served by a base station. To communicate with each other, mobile phones and base stations exchange radio signals. The user connects to the base station via the handset and the system ensures that the connection is maintained as the user moves from one cell to another.

When a mobile phone is switched on, it responds to specific control signals from nearby base stations. Once it has located a suitable base station the phone initiates a network connection. The phone remains dormant, aside from occasional updates, until a call is made or received.



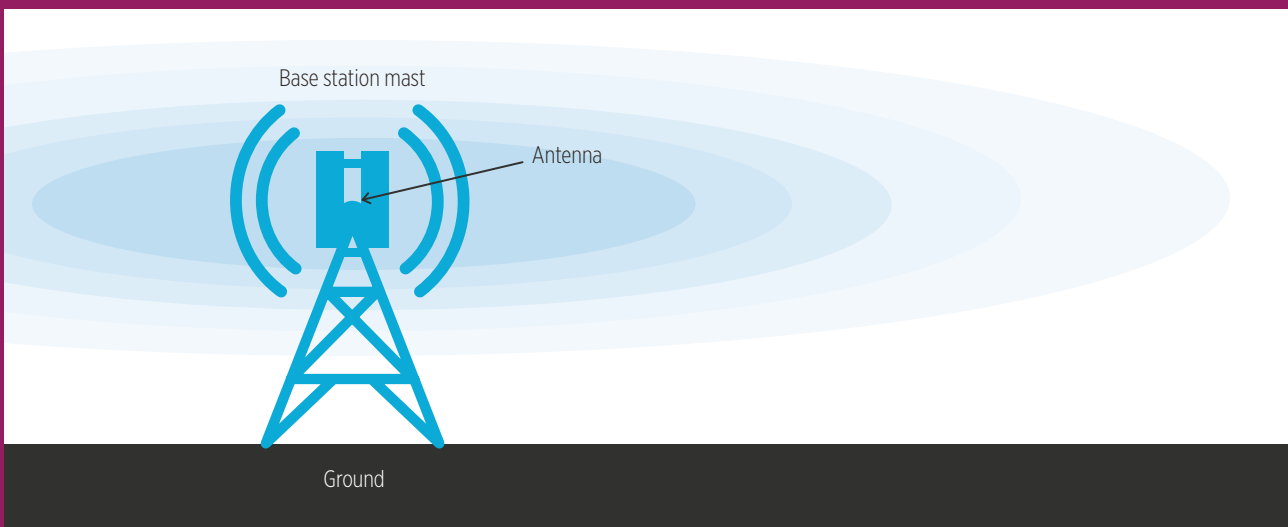
## What is a base station?

Transmitted power levels vary depending on the geographical area of the cell, but the range is anything from less than a watt to 100 watts or more; lower for indoor base stations.

At an outdoor site, one or more antennas transmit the radio signals. Each is typically 15-30 centimetres in width and 1-3 metres high, depending on the frequency of operation. The transmit pattern of the antennas is narrow vertically, but broad horizontally, so that the radio signal level directly beneath the antennas is very low. Typical levels in publicly accessible areas are 50-50,000 times below international safety recommendations.

Figure 2

### Base Stations: Beam shapes and directions



“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.”

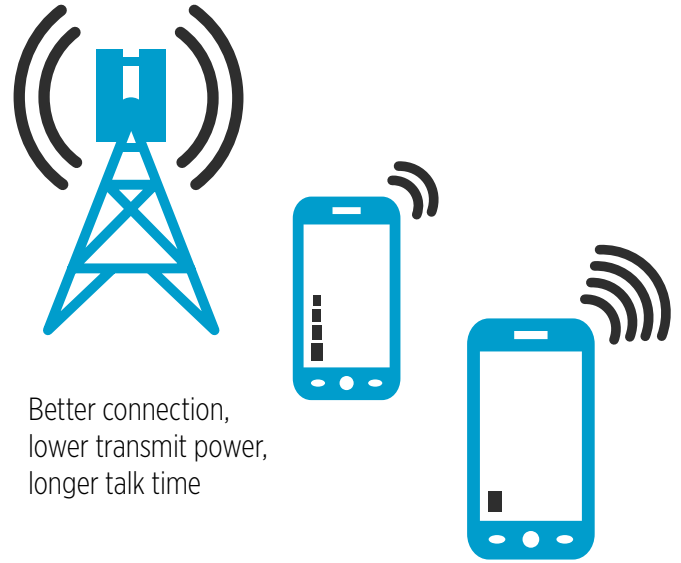
WHO, September 2013

## Mobile phones

Compliance of mobile phones is based on assessment of the Specific Absorption Rate (SAR), which is the unit of measurement for the amount of RF energy absorbed by the body. The SAR is determined at the highest certified power level in laboratory conditions, however, the actual SAR level of the phone while operating can be well below this value.

Mobile phones use adaptive power control to reduce the transmitted power to the minimum possible whilst maintaining good call quality. This prolongs talk time and minimises interference to other callers. For example, during a voice call the average power output of a phone can vary from 0.001 watt up to the maximum level which is less than one watt. When coverage is good, such as close to a base station, the output level may be similar to that of a home cordless phone.

The view of the WHO is that the international exposure recommendations are protective of all persons and that no special precautions are needed for mobile phone use. If individuals are concerned, they might choose to limit their exposure by limiting the length of calls, or using 'hands-free' devices to keep mobile phones away from the head and body. Bluetooth earpieces use very low radio powers and will also reduce exposure.





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## Handsfree kits and shields

Various products are being marketed that claim to increase the safety of mobile phone use. These products generally take the form of shielded cases, earpiece pads/shields, antenna clips/caps, special batteries and absorbing buttons.

A mobile phone automatically operates on the lowest power necessary to maintain call quality. If an add-on device adversely affects the phone's antenna, the phone will attempt to transmit more power up to its specified maximum.

Scientific evidence does not indicate any need for shields on mobile phones. They cannot be justified on health grounds and the effectiveness of many such devices in reducing exposure is unproven. If individuals are concerned, personal hands-free devices have been shown to reduce exposures by at least a factor of 10 by allowing the phone to be used away from the head and body.

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## Children and radio signals

Some parents are concerned about whether there are health risks for children using mobile phones or where base stations are sited close to schools, day care centres or homes.

National authorities in some countries have recommended precautionary restrictions on phone use by younger children due to concern about possible greater vulnerability and to limit longer lifetime exposures if there is an unrecognised health risk.

The WHO has concluded that current scientific evidence does not justify specific measures and that international safety guidelines are protective of all persons, including children and pregnant women.

## FAQs and Myths

### **I've read that mobile phones can cause cancer. Is this true?**

There are no established health risks from the radio signals used by mobile phones. Some studies have suggested increased brain cancer risk for long-term users but there are limitations to the studies and a lack of evidence of cancer increase in national health registries. Due to these uncertainties, the WHO recommends that research should continue.

### **What does the classification of radio signals as a possible carcinogen mean?**

In May 2011, a specialist cancer agency of the WHO concluded that there was a possible cancer hazard from radio signals based on limited evidence from human and animal studies. Health authorities advise that more research is needed and remind mobile phone users that they can take practical measures to reduce exposure such as use of a hands-free kit.

### **What about other health risks?**

Independent scientific institutions around the world review relevant research as it is published. The consensus of these expert groups is that there is no demonstrable evidence of a risk to human health from mobile phone radio signals.

### **How can we be sure that this research is accurate?**

Sophisticated and sensitive research methods using well-validated models for assessing health risks from other agents have been applied to investigate the safety of mobile phones. Many research institutions and the guidelines according to which such research is conducted, are controlled by government and independent bodies around the world. Research results are continually reviewed at an international level by organisations such as the ICNIRP and the WHO.

### **I live close to a base station. Am I at risk?**

The consensus scientific view is that there are no health risks from living near a base station. Mobile phone base stations use low power radio transmitters to reduce interference to nearby sites. Recent measurement surveys show that exposures to base station radio signals range from 0.002 per cent to two percent 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. It is only in areas close to the antennas that the recommended limits may be exceeded and the network operator prevents public access to these areas by placing the antennas near the top of the mast or high on a building.

### **Why are there so many restrictions on using mobile phones in hospitals?**

At short range, the radio signal from a mobile phone may cause interference with electronic medical devices. At distances greater than one to two metres, the possibility is substantially reduced. It is possible for mobile phones to be used in designated areas of hospitals.

### **Why can't I use my mobile phone when I fly?**

It is standard practice on aircraft to turn off all types of radio transmitters and certain other electrical devices unless they have been demonstrated not to cause interference to aircraft systems. There have been recent successful trials of mobile phone use on aircraft in Europe and the USA, and plans for commercial operations have been announced.

### **I've heard reports of mobile phones causing explosions at petrol stations, is this true?**

There is no evidence of any established link between radio signals from mobile phones or base stations and petrol station fires. In fact, a 2005 report for the Australian Transport Safety Bureau concluded that of 243 reported incidents around the world none were associated with telecommunication equipment; instead, many of the fires were ignited by the discharge of static electricity from the human body.

### **How do we know that new radio technologies are safe?**

There is a large body of existing scientific research that has been used to develop safety standards. Expert groups have not established any signal specific effects, so the scientific consensus is that compliance with current safety standards is sufficient for newer technologies and provides protection against all established health hazards.

## FAQs and Myths

### **Are some people more sensitive to radio signals?**

No. The WHO has concluded that while self-reported headaches and other symptoms are real, there was no scientific basis to link the symptoms to exposure to radio signals. Furthermore, the WHO says that treatment should focus on medical management of the health symptoms and not on reducing exposure to radio signals.

### **I've read stories claiming that mobile phones can affect male fertility and sperm quality, is this true?**

Some preliminary scientific studies have reported a link, however, these studies have generally not properly accounted for lifestyle factors, for example, diet, smoking, etc. The consensus view of expert public health bodies, including the WHO, is that there are no adverse health effects associated with the radio signals used by mobile phones or base stations.

### **Should I be concerned about the wireless network in my office or at my child's school?**

The UK Health Protection Agency advises that on the basis of current scientific information wireless computer networks satisfy international guidelines and, therefore, there is no reason why schools and others should not use this equipment. In addition, the WHO states that '...there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects.'

### **Are the stories that mobile phones can cook eggs or make popcorn pop really myths?**

They are both myths. There is simply not enough power from a mobile phone to produce either effect. A mobile phone has a maximum average power of about 0.25 watts, compared to 900 watts or more from a microwave oven.

### **Does a lower SAR mean that a phone is safer?**

No. Variations in SAR do not mean that there are variations in safety. While there may be differences in SAR levels among phone models, all mobile phones must meet RF exposure guidelines.

### **Where can I get the SAR value for my phone?**

SAR information for many phones is now included with the instructions as well as being published on the company website or at [www.sartick.com](http://www.sartick.com).

## KEY REFERENCE SITES FOR MOBILE PHONES AND HEALTH

World Health Organization  
[www.who.int/emf](http://www.who.int/emf)

European Commission  
[http://ec.europa.eu/health/electromagnetic\\_fields/](http://ec.europa.eu/health/electromagnetic_fields/)

U.S Federal Communications Commission  
[www.fcc.gov](http://www.fcc.gov)

International Telecommunications Union  
[www.itu.int/en/ITU-T/emf/](http://www.itu.int/en/ITU-T/emf/)

International Commission on Non-Ionizing Radiation Protection  
[www.icnirp.org](http://www.icnirp.org)



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