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Radiation, Mobile Phones, Base Stations and Your Health

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Ng Kwan-Hoong, Ph.D.



Suruhanjaya Komunikasi dan Multimedia Malaysia
Malaysian Communications and Multimedia Commission

Many of us in Malaysia use mobile phones to communicate with one another at work, at home or for convenience from just about anywhere we are! Mobile phones have become very much a part of our way of life.

There are, however, some of us who are concerned about the health and safety effects related to the use of mobile phones and on transmission from base stations.

It is with this in mind that **Radiation, Mobile Phones, Base Stations and Your Health** attempts to make radiation from mobile phones system more understandable and also to separate myth from fact.

Find out in this book ...

- What is radiation?
- Is natural radiation dangerous?
- Are there any health risks if you live or work near a base station?
- What are the effects of RF radiation?
- What is Specific Absorption Rate (SAR)?
- Can I get cancer and other related illness from using mobile phones?
- Does Malaysia have safety standards and guidelines for mobile phone base stations?

Professor Ng Kwan Hoong

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Foreword by



Y. Bhg. Tan Sri Dr. Mohamad Taha bin Arif

Director-General, Ministry of Health

First and foremost, I wish to extend my heartiest congratulations to Professor Ng Kwan Hoong for his commendable efforts in producing this highly informative publication entitled ***Radiation, Mobile Phones, Base Stations and Your Health***. This timely publication does not only provide general background information on the health effects from mobile phones and base stations but also helps to alleviate anxiety of the general public.

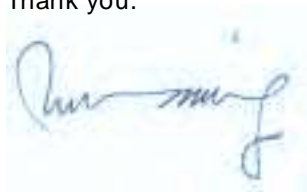
With the technology rapidly advancing, mobile phone users and people living within close range of the mobile phone base stations have become increasingly concerned over the potential harmful effects of radiofrequency radiation produced by these devices to their health.

The Ministry of Health has always been striving to play an effective role as the guardian of public health. In 1996, the Ministry appointed an interagency scientific committee to study and produce a report on the health effects of electromagnetic fields (EMF). This committee concluded that there is no conclusive evidence to indicate that EMF exposures at levels normally encountered will cause harmful health effects. The above is also the findings of the world scientific and medical community. This committee still monitors the current research worldwide and reports to the Ministry of Health periodically.

Nevertheless, there continues to be a great deal of misunderstanding and misinformation on the issue of safety and radiation. I am therefore very pleased that this book endeavours to promote a better understanding of what is known and not known about radiofrequency radiation, as well as to separate the myths from the facts.

Once again, I applaud Prof. Ng on his efforts and his continuing contribution towards promoting better understanding of radiation, in particular, its use in the medical field.

Thank you.

A handwritten signature in blue ink, appearing to read 'Taha Bin Arif', is centered on a light blue rectangular background.

TAN SRI DR. MOHAMAD TAHA BIN ARIF

Introduction



The telecommunications industry is experiencing a robust growth on a global scale. By the year 2005, the industry predicts that there will be as many as 1.6 billion mobile phone subscribers worldwide. Since the introduction of mobile phones in the mid-1980s, there has been a significant increase in the number of mobile phone users and installations of base stations. As of 2003, statistics from the Malaysian Communications and Multimedia Commission (MCMC), show that the mobile penetration rate is 39 persons per 100 population or 9.7 million subscribers.

Mobile phones, sometimes known as cellular phones or handsets, form an integral part of modern telecommunications and are fast becoming a social lifestyle. In some parts of the world, they are the most reliable or the only phones available. In others, mobile phones are very popular because they allow people to maintain constant and continuous communication without hampering their freedom of movement.

How does a mobile phone system work? The individual mobile phone operates by communicating with a fixed installation known as a base station or a telecommunications structure. Since the mobile phone and its base station is a two-way radio, they produce radiofrequency (RF) radiation as a means of communicating and expose the people near them to RF radiation.

The wide use of mobile phones has inevitably raised the question of whether there are any implications for human health. There have been some reports relating to possible adverse health effects and these have understandably led to some concern from the members of the public.

In ***Radiation, Mobile Phones, Base Stations and Your Health***, issues regarding human health effects from mobile phones and their base station antennas are addressed and discussed in the Frequently Ask Questions (FAQ) manner. While some of the issues discussed are international, however, general issues of technical and regulatory aspects of this FAQ, are specific to Malaysia.

Our perception about radiation and health shapes our actions concerning it and our actions influence the future of important services and functions. It is with this in mind that this book attempts to make radiation from mobile phone system more understandable to the members of public and to try to separate the myths from facts.

For now, we can conclude that there is no consistent and convincing scientific evidence of adverse health effects caused by RF radiation. Meanwhile, further ongoing research based on established scientific methods will continue to shed light on our understanding of this important health issue.

Eight Myths About Mobile Phones and Base Stations

<i>MYTH</i>	<i>FACT</i>
<ul style="list-style-type: none"> • Mobile phones cause brain cancers - look at all those people who used mobile phones and are ill. 	<ul style="list-style-type: none"> • Despite individual cases, there is no scientific evidence that it is anything but chance.
<ul style="list-style-type: none"> • Mobile phones are so powerful that they literally cook your brain. 	<ul style="list-style-type: none"> • Mobile phones typically have an output of less than 1 watt that may cause heating in the brain of fractions of a degree, less than normal exercise.
<ul style="list-style-type: none"> • You are safer using a mobile phone in a car because it shields you from the radiation. 	<ul style="list-style-type: none"> • Phones automatically increase their input in a car to overcome the shielding. A 'car kit' often uses an external antenna that will reduce the power levels.
<ul style="list-style-type: none"> • Using them in a car does not affect your driving skills. 	<ul style="list-style-type: none"> • You are 4 times more likely to crash because of divided attention, and it is similar to drunk-driving.
<ul style="list-style-type: none"> • It is the base stations that are really dangerous. 	<ul style="list-style-type: none"> • At the ground level, the intensity of radiofrequency radiation from base stations are less than one thousandth of those from mobile phones and are generally much less than those from the local radio and television stations.
<ul style="list-style-type: none"> • The cases of brain cancer are increasing as more people use mobile phones. 	<ul style="list-style-type: none"> • There is no evidence of a rise among young people – any increase will be among people in their 70s.
<ul style="list-style-type: none"> • Using a mobile phone gives you headaches. 	<ul style="list-style-type: none"> • People get headaches without using mobile phones, too – there is no evidence of a direct link.
<ul style="list-style-type: none"> • Nobody is really investigating the dangers. 	<ul style="list-style-type: none"> • The World Health Organization and many government agencies are coordinating scientific studies to investigate these health effects.

Frequently Asked Questions



Why is there a great concern on the health effects of a mobile phone system?

Millions of people around the world use mobile phones as a communication tool everyday. Base stations or telecommunication towers are continuously being erected. Because of this, scientists worldwide are concerned about the potential health risks associated with the use of this device. Even small adverse effects on health could have major public health implications. Moreover, radiofrequency is an abstract subject and is not easily understood by people. The term 'radiation' often conjures fear and scare. A tremendous amount of publicity generated in the mass media has also caused great concern among members of the public.



What is radiation?

Radiation is a form of energy on the move. Radiation is electromagnetic in nature, i.e., it consists of waves of electric and magnetic energy moving together through space at the speed of light. We live in a radiation world and are exposed to both natural and man-made radiation. Every second of our life, we are exposed to all forms of radiation such as ultraviolet light from the sun and radio waves from radio and television broadcasts. When we go for a chest x-ray examination, we are exposed to x-rays.

There are two types of radiation:

◆ **Ionizing radiation**

It contains enough energy to cause ionization. Ionization is a process by which electrons are stripped from atoms and molecules. Its interaction with matter can change chemical reactions in the body that leads to damage in biological tissues including effects on

DNA (deoxyribonucleic acid) – the genetic material. Gamma rays and x-rays are two forms of ionizing radiation.

◆ **Non-ionizing radiation (NIR)**

It does not have sufficient energy to cause ionization in living matter. It causes some heating effect, but usually not enough to cause any kind of long-term damage to tissues. Radiofrequency energy, visible light and microwave radiation are considered non-ionizing.

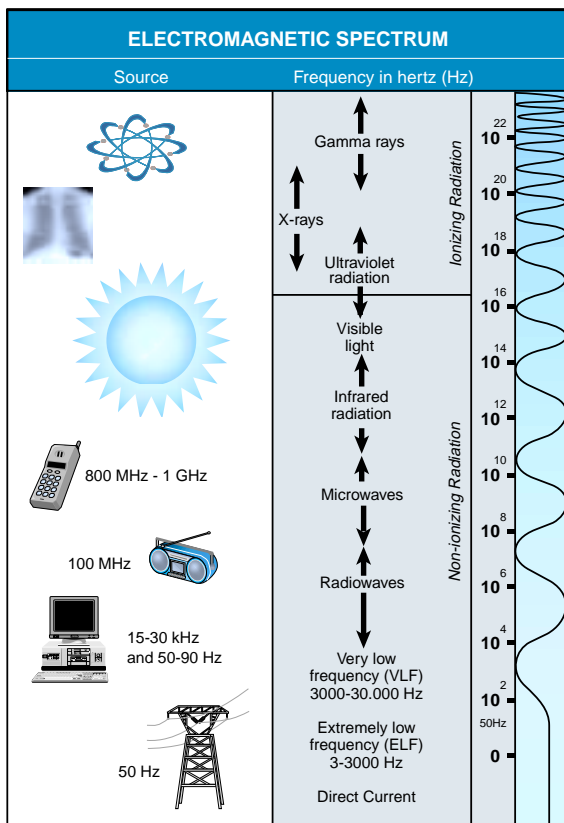


Fig. 1 The Electromagnetic Spectrum

For the same strength, ionizing radiation is more capable of causing health effects than non-ionizing radiation due to the ionization process.



How does radiation behave?

Radiation behaves in the same manner as light. It travels in a straight line and when it collides with an object, it can do three things — it can pass right through (transmission), it can bounce off (reflection), and it can be absorbed. It readily reduces its energy as it moves away from its source where radiation is produced. This means that a person will receive less exposure if he/she stays indoors compared to staying outside or keep a distance compared to standing close to the source.



Is natural radiation dangerous?

We are being continuously exposed to many sources of natural radiation. Of these sources, the sun is the most familiar to us as it produces infrared radiation, visible light, and ultraviolet light. The other sources are cosmic radiation that consists of high energy particles and rays that originate from outside our earth, terrestrial radiation that comes from naturally occurring radioactive materials in the earth's crust, and internal radiation from radioactivity that is naturally present in our bodies.

Of these, only the ultraviolet light from the sun can be considered 'dangerous'. Over-exposure to the sun's ultraviolet light can cause premature aging of the skin and cause sunburn, which has been linked to skin cancer. Although the nature of cosmic, terrestrial, and internal radiation is inherently hazardous and can cause cancer, these sources are not normally dangerous to us as the

levels present naturally are sufficiently low that the risk is negligible.



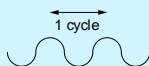
What is electromagnetic field (EMF)?

Electromagnetic radiation consists of waves of electric and magnetic energy moving together through space at the speed of light. Often the term 'electromagnetic field' or EMF is used to indicate the presence of electromagnetic radiation.

Different forms of electromagnetic radiation are classified by their frequencies. The term EMF is generally used to cover fields in the frequency range below 300 gigahertz (GHz), where giga refers to a thousand million. EMF includes electric and magnetic fields from the electricity supply at power frequencies (50 Hz in Malaysia), and radio waves from TV, radio and mobile phones, radar and satellite communications. Many home devices also transmit EMF such as cordless phones and radio-controlled toys.

Frequency

Frequency is measured in Hertz (Hz)
1 Hz = 1 cycle per second



kHz	=	kilohertz	=	1000 Hz
MHz	=	megahertz	=	1000 000 Hz
GHz	=	gigahertz	=	1000 000 000 Hz

Example:

Source:

Power line

Mobile phone

Frequency:

50 Hz

900 MHz



What is radiofrequency (RF)?

A radio signal can be thought of as a wave that spreads out from its source (the antenna). It is often referred to as an *electromagnetic wave* that is made up of linked electric and magnetic components. The radiofrequency (RF) part of the electromagnetic spectrum includes electromagnetic waves produced by television and radio transmitters (including base stations) and microwaves. The electric and magnetic components that form the electromagnetic wave can be referred to as *radiofrequency fields*.

When the announcer of a radio station says, 'You are listening to 95.8 FM' what the announcer means is that you are listening to a radio station broadcasting a FM radio signal at a frequency of 95.8 megahertz.



Fig. 2 Exposure to radiofrequency radiation in everyday life.



What is a mobile phone? Does it emit large quantities of RF radiation?

A mobile or cellular phone is a low-power, single-channel, two-way radio. It contains both a transmitter and a receiver. It emits RF radiation to transmit information to the base station. It also acts like a receiver of information, in a similar manner as a transistor radio. The handset battery limits the power of transmitted radiation, which is similar, if not smaller than, that of a torchlight. The radiation emitted by the antenna is insufficient to cause any significant heating of tissues in the ear or head, although a rise in skin temperature may occur as a result of placing the mobile phone too close against the ear or head thus restricting the airflow.

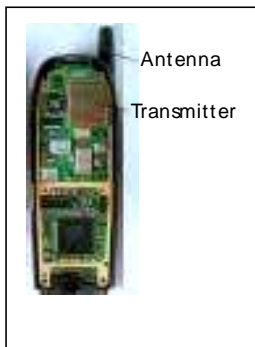


Fig. 3 Radiation in a mobile phone is generated in the transmitter and emitted through the antenna.



Besides the RF radiation from a mobile phone system, are there any other RF sources that I am exposed to?

Yes. You are exposed to RF radiation originating from paging and other communications antennas such as those used by the fire, police and emergency services, that operate at similar power levels as base stations, and often at a similar frequency. In many urban areas, television and radio broadcast antennas commonly transmit higher RF radiation levels than the mobile phone base stations.



What are mobile phone base stations and how do they work?

Mobile phone base stations are also known as base transceiver stations or telecommunications structures. They are low-power, multi-channel two-way radios. Antennas, which produce RF radiation, are mounted on either transmission towers or roof-mounted structures. These structures need to be of a certain height in order to have a wider coverage. When you communicate on a mobile phone, you are connected to a nearby base station. From that base station your phone call goes into the regular fixed-line phone system.

As the mobile phones and their base stations are two-way radios, they produce RF radiation to communicate and therefore expose the people near them to RF radiation. However, as both the phones and the base stations have low-power (short range) transmitters in them, the RF radiation exposure levels are generally very low.

(a) A Transmission Tower



(b) A Roof top Structure



Fig. 4(a) & (b) Mobile phone base stations



Are there health risks associated with living or working near a base station?

The consensus of the international scientific community is that the power from these mobile phone base station antennas is far too low to produce health risks as long as people are kept away from direct contact with the antennas.

You have to know the difference between antennas and towers. It is the antennas that you need to keep your distance from and *not* the towers that hold the antennas.

You also need to be aware of the many different designs of mobile phone base stations that vary widely in their power and characteristics, as well as their potential for exposing people to RF radiation.



How safe are the base stations?

In Malaysia, base stations are installed in compliance with the stringent guidelines set by the Malaysian Communications and Multimedia Commission and the Ministry of Housing and Local Government, which conform to international standards and best practices of safety.

In addition to local standards the following international agencies are the International Commission on Non-ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE) and the World Health Organization (WHO).



Is there a scientific basis for these RF radiation safety standards?

Yes. Over the past few decades, scientists have been researching the biological effects of RF radiation on animals and humans. The results were published in scientific journals and have been extensively reviewed by international organizations.



Does Malaysia have safety standards and guidelines for mobile phone base stations?

Yes. The Malaysian Communications and Multimedia Commission (MCMC) Guidelines on permissible radiation levels, released in August 1998, are based on international standards developed to minimize the possible impact of radiation on health. The MCMC continues to monitor the latest safety standards recommended by world organizations such as the International Commission on Non-ionizing Radiation Protection (ICNIRP) and the World Health Organization (WHO) to ensure that the guidelines adopted for Malaysia remain current.



Do mobile phone base station antennas meet the safety standards?

Yes. With proper engineering design, installation and regulatory control, mobile phone base station antennas can meet all the national and international safety standards.

The Malaysian Institute for Nuclear Technology Research (MINT) has measured exposures around many base stations and found that the maximum exposures around the great majority of base stations are less than 1 per cent of the public exposure limit set by the safety standards. Exposures seldom exceed a few percent of the limit and none have been above 10 per cent.



What can the consumers do to influence the siting of base stations?

Mobile operators should comply with the guidelines and standards set by the relevant regulatory bodies. Base station sites must offer good signal coverage and be accessible for maintenance. While RF radiation levels around base stations are not considered a health risk; siting decisions should take into account aesthetics and public sensibilities.

However, as consumers, you too have a role to play. You can influence the decision to locate or site the base stations in your area. Siting base stations near kindergartens, schools and playgrounds may need special consideration. Open communication and discussion between the mobile phone operators, local councils and the public during the initial planning stages for a new base station, can help create public understanding and greater acceptance of a new facility.



What are the international organizations doing regarding the health effects of RF radiation?

Public concern in many countries regarding mobile phones and base stations has resulted in a number of international and national organizations and independent expert groups being requested by governments to carry out detailed reviews of the research literature.

The World Health Organization International Electromagnetic Fields (EMF) Project was started in 1996. An important result of this work has been the development of a detailed agenda of research needs, that has driven the establishment of new research programmes around the world. It aims to harmonize the safety standards for all countries in the world. The Project has

also helped develop a series of public information documents on EMF issues.



What are the findings of recent reviews from some of these international organizations?

The most recent reviews, and brief quotes from their findings are presented below.

‘No consistent increases in health risk due to exposure to RF radiation are evident to date. It appears that exposure of the public to RF fields emitted from wireless telecommunications base stations is of sufficiently low intensity that biological or adverse health effects are not anticipated.’

The Royal Society of Canada 1999

‘Despite the rather limited epidemiological and experimental data available, NRPB concludes that the totality of the evidence available does not suggest that the use of mobile phones have any detrimental effect on human health. Nevertheless, there does remain a need for further research.’

U.K. National Radiological Protection Board (NRPB) 1999

‘None of the recent reviews have concluded that exposure to the RF fields from mobile phones or their base stations causes any adverse health consequence. However, there are gaps in knowledge that have been identified for further research to better assess health risks. It will take about three to four years for the required RF research to be completed, evaluated and to publish the final results of any health risks.’

The World Health Organization (WHO) 2000

‘The balance of evidence to date suggests that exposure to RF radiation below ICNIRP guidelines do not cause adverse health effects to the general population.’

‘We conclude that the balance of evidence indicates that there is no general risk to the health of people living near to base stations on the basis that exposures are expected to be small fractions of guidelines.’

The United Kingdom Independent Expert Group Report (also known as the Stewart Report) 2000

‘FDA has been receiving inquiries about the safety of mobile phones, including cellular phones and Personal Communication Services (PCS) phones. Mobile phones emit low levels of radiofrequency (RF) energy (i.e., radiofrequency radiation) in the microwave range. High levels of RF radiation can produce biological damage, but it is not known whether lower levels of RF radiation might cause adverse health effects as well. Although some research has been done to address these questions, no clear picture of the biological effects of this type of radiation has emerged to date. Thus, the available science does not allow us to conclude that mobile phones are absolutely safe, or that they are unsafe. However, the available scientific evidence does not demonstrate any adverse health effects associated with the use of mobile phones.’

U.S. Food and Drug Administration (FDA) 2001



What is the present position of the Malaysian government agencies?

In 1996, the Ministry of Health established the Interagency Ad-Hoc Scientific Committee to study the public health issues arising from the mobile phone technology. The conclusion reached was that there was inconclusive scientific evidence indicating that EMF exposures at levels normally encountered will cause harmful health effects. The above is also the findings of the world scientific and medical community. The committee continues to monitor the situation and advises the government periodically.



What are the effects of RF radiation?

RF radiation 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.

There is some discussion about other effects caused by RF radiation other than by thermal effect. However, no evidence is established yet.

The scientific community and international bodies acknowledge that further research is needed to improve our understanding in some of these areas. At the moment, there is insufficient and inconclusive scientific findings to prove any adverse health effects caused by RF radiation.



How safe is the mobile phone system? Can it cause cancer and other illnesses?

Some studies have also examined the possibility of a link between RF radiation exposure and cancer. The results to date have been inconclusive. While some experimental data may suggest a possible link between exposure and cancer formation in animals exposed under certain specific conditions, the results have not been independently reproduced. In fact, other studies have failed to find evidence for a causal link to cancer or any related condition. Further research is underway in several laboratories to help resolve this issue.

In recent years, publicity, speculation, and concern over claims of possible health effects due to RF radiation from base stations and mobile phones have prompted many research organizations to investigate the potential health effects from the use of mobile phones.

To date, there is inconclusive scientific evidence to prove that the mobile phone system can lead to cancer or a variety of other health effects, including headaches, dizziness, memory loss or birth defects.



What is Specific Absorption Rate (SAR)? How can I use it?

SAR is a measure of the amount of RF energy that is absorbed by the tissues in the human body. It indicates the average rate at which energy is absorbed for each kilogram of tissue (watts per kg). This measurement is used to determine whether a mobile phone complies with the safety guidelines.

The exposure limit takes into consideration the body's ability to remove heat from the tissues that absorb energy from the mobile phone and is set well below levels known to show biological effects.

The U. S. Federal Communications Commission (FCC) limit for RF radiation exposure from mobile phones is set at a SAR of 1.6 watts per kilogram (1.6 W/kg). ICNIRP recommends that the localized SAR in the head be limited to 2 W/kg averaged over any 10g mass of tissues in the head (0.02 W absorbed in any 10g mass of tissue in the head). A SAR of 4W/kg is associated with a temperature rise in humans of a fraction of a degree Celsius.



Where can I obtain SAR value for my mobile phone?

Mobile phone manufacturers must ensure that their products comply with the SAR levels that have been set as safe although there is a range of SAR values in the products sold. You may wish to take the SAR value into consideration when choosing a mobile phone, hence the move to provide this information.



What steps can I take to reduce my exposure to RF radiation from my mobile phone?

If you are concerned about avoiding even potential risks, here are a few simple steps that you can take to help minimize your exposure to RF radiation.

Since time is a key factor in how much exposure a person receives, the shorter the time you spend on a mobile phone, the smaller the RF radiation exposure. You could use a hands-free kit or use a mobile phone connected to a remote antenna to increase the distance between your body and the source of the RF radiation, since the exposure level drops off dramatically with distance.

Again, the scientific data does not demonstrate that mobile phones are harmful. However, if you are concerned about the RF radiation exposure from these products, you can use measures described above to reduce your RF radiation exposure from mobile phone use.



What is the advice for children using mobile phones?

The scientific evidence does not show a danger to mobile phone users, including children and teenagers. If you want to take steps to lower the exposure to RF radiation, the measures described above could also apply to children and teenagers. Reducing the time of mobile phone use and increasing the distance between the user and the RF radiation source will reduce the RF radiation exposure.

In December 2000, the United Kingdom government recommended limiting the use of mobile phones by children as a precautionary measure. It was, however, noted that no evidence exists to suggest that using a mobile phone causes brain cancer or other health effects.

The *U.K. Stewart Report* states:

'If there are currently unrecognized adverse health effects from the use of mobile phones, children may be more vulnerable because of their developing nervous system, the greater absorption of energy in the tissues of the head, and a longer lifetime of exposure. In line with our precautionary approach, we believe that the widespread use of mobile phones by children for non-essential calls should be discouraged. We also recommend that the mobile phone industry should refrain from promoting the use of mobile phones by children.'



So why is anyone still worried?

It is only natural for the members of the public to worry whenever there is a health scare as this is how they perceive risk. The tremendous amount of publicity on this health issue has also caused further confusion and uncertainty. A few years back, experiments conducted on animals suggested that mobile phone radiation might

cause cancer or damage DNA. While these findings have been reported, further animal studies have also suggested that RF radiation is harmless.

Secondly, science is unable to prove that something is absolutely safe and harmless. And scientists are seldom able to say the word 'never' an assurance that the public wants.

Thirdly, as health scare has always acquired a life of their own, once it is suspected that mobile phones could be dangerous, many people would come forward to heap blames on them as the probable cause for the death of their loved ones or any illness that they may have. Although there is inconclusive evidence, no amount of proof of research will likely erase such doubts.

Presently, no recognized expert is of the opinion that the radiation from television towers and other microwave-emitting antennas is linked to leukaemia. Whatever little evidence that existed before has since been squashed. Yet, in many countries, ongoing campaigns have been carried out to stop these towers from being built.

In the 1960s, the public were suspicious and unduly worried about the x-ray exposure from their colour television. In the 1980s, electromagnetic fields from computer terminals have been erroneously linked as the main cause of miscarriages, birth defects and other health problems. Again, these claims have been overturned. In the 1990s, with the internet revolution, experts have begun to raise their concerns over the internet addiction among its users.



Where can I get more information?

There are many informative and authoritative web sites maintained by international organizations and government agencies where you can get further information. These include:

- ◆ The World Health Organization (WHO). The World Health Organization established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of electric and magnetic fields, including the radiofrequency fields from mobile phone. They have a fact sheet on 'Electromagnetic fields and public health' that deals with issues relating to radiation around mobile phones and base stations available at <http://www.who.int/inf-fs/en/fact193.html>
Other information on the project can be found at <http://www.who.int/peh-emf/en/>
- ◆ The International Agency for Research on Cancer (IARC) INTERPHONE project is described in <http://www.iarc.fr>
- ◆ New information leaflets published by the U.K. Department of Health can be found at: <http://www.doh.gov.uk/mobilephones/index.htm>
- ◆ Independent Expert Group on Mobile Phones Report (also known as the *Stewart Report*) – this report was published in May 2000 by an independent expert group established by the U.K. government <http://www.iegmp.org.uk>
- ◆ Royal Society of Canada. A review of the potential health risks of radiofrequency fields from wireless telecommunications devices. Expert panel report prepared by the Royal Society of Canada for Health. Ottawa, Royal Society of Canada (1999). <http://www.rsc.ca/english/RFreport.pdf>

- ◆ The Institute of Electrical and Electronics Engineers (IEEE) Online journal Spectrum article “Are mobile phones safe?”
<http://www.spectrum.ieee.org/publicfeature/aug00/prad.html>
- ◆ IEEE Committee on Man and Radiation (COMAR) also publishes reports on the safety and human exposure to electromagnetic fields.
<http://www.seas.upenn.edu/~kfoster/comar.htm>
- ◆ A consumer update on mobile phones produced by the United States FDA is available at
<http://www.fda.gov/cellphones/>
- ◆ A highly respected Internet site on health and safety issues relating to electromagnetic fields by J. Moulder, Medical College of Wisconsin, U.S.A.
<http://www.mcw.edu/gcrd/cop/cell-phone-health-FAQ/toc.html>

Additional Information/ Links

INTERNATIONAL

- ◆ World Health Organization (WHO) International EMF Project
<http://www.who.int/peh-emf/en/>
- ◆ International Commission on Non-Ionizing Radiation Protection (ICNIRP)
<http://www.icnirp.de>



If you wish to contact the Malaysia Communications and Multimedia Commission regarding this or any other issues, please send your enquiries to:

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