



Risky radiation

Comparing mobile phones and UV sunbeds

It is not uncommon for the general public to be misinformed about the risks associated with radiation. In this article, Peter Cole of Liverpool University contrasts two examples of technology that emit non-ionising radiation.

Mobile phones emit radiofrequency (RF) radiation. Tanning beds emit ultraviolet (UV) radiation. These are both types of non-ionising radiation. In recent years both have received considerable media coverage, and they are emotive topics for the general public.

In assessing radiation risks, we need to consider two factors:

- the type of radiation and the effects it may have on the human body
- the amount of radiation to which a person is exposed.

Mobile phone radiation

There are approximately 50 000 mobile phone base stations in the UK. These are the low-power antennae often seen on towers or on top of buildings. They transmit a few tens of watts at frequencies of around 2 GHz. This is electromagnetic radiation in the radio wave region of the electromagnetic spectrum and is known as **RF radiation**.

The photograph (Figure 1) shows two types of transmitters: tall, thin 'sector' antennae which communicate with mobile phone handsets, and 'dish' antennae which connect one base station to another.



Figure 1 Two types of antennae at a mobile phone base station. Each type both transmits and receives RF radiation.

RF radiation from a sector antenna is directed outwards in the form of a conical beam (Figure 2). This is aimed at the horizon (like the beam from a lighthouse) with a slight downward tilt of approximately 10 degrees. The beam usually touches the ground at a distance of about 150 metres

Key words

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A frequency of
2 GHz (2 gigahertz)
is 2 billion hertz or
 2×10^9 Hz.

depending on the height of the tower. Because the beam spreads out, the intensity of the radiation (measured in watts per square metre) reduces very quickly with distance from antenna.

RF exposure limits are set by the International Commission on Non-Ionising Radiation Protection. On the ground the levels of RF exposure are small fractions of a percentage of the safe limit. So low is the amount of RF at ground level that it is extremely difficult to measure. Also, due to the horizontal direction of the beams, the lowest power emissions from a tower are actually to be found directly underneath the antennae at the foot of the tower itself. You would have to be directly in front of a base station and just a few metres from it to exceed the internationally agreed limits of RF exposure.

like those from mobile technology actually *cause* health problems such as cancer? Research on this tricky question is fairly incomplete, largely inconsistent, and vastly misunderstood.

The energy of a radiofrequency photon is about one million times less than the energy required to break a chemical bond. So the emissions from mobile phone technology cannot directly break a DNA molecule. If there is a causal mechanism that links RF to cancer then it has proven to be most elusive and must involve an extremely subtle physiological or biochemical process. To date no such mechanism has been identified. The risks to health, if any exist, are likely to be exceedingly small. Some studies may show a correlation between RF and cancer but that does not mean that there is any

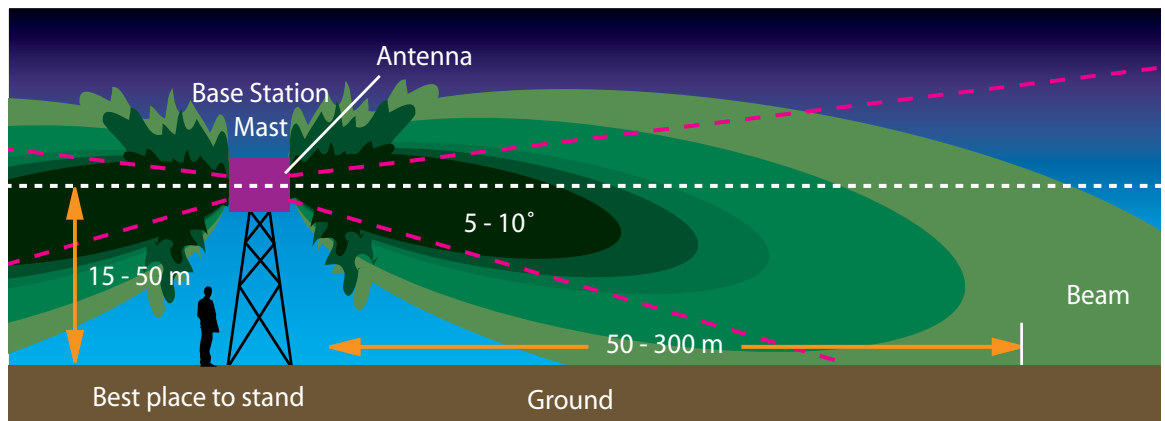


Figure 2 RF radiation spreads out from a sector antenna in the form of a widening beam. The darker the shading, the more intense is the radiation.

Building materials absorb and so attenuate RF to a certain extent but not completely, otherwise you'd never receive a phone call indoors.

The National Radiological Protection Board (now called the Health Protection Agency) have carried out surveys throughout the UK of RF emissions from base stations sited near schools or within school premises, on blocks of flats and other residential areas, and on office blocks. In all cases the RF power density measured was less than 0.2% of guideline exposure values.

Biological effects

The biological effects of RF electromagnetic radiation can be divided into two categories. Thermal (or heating) effects are incontrovertible and scientifically well understood. These are how a microwave oven heats up food. They are also the effects on which RF exposure limits are based. Protection from these effects is simply a matter of staying more than a few metres away from a base station antenna.

It is the athermal (or non-heating) effects that are still open to debate throughout the worldwide scientific community. Can EMF exposure lead to athermal biological effects? Do the RF transmissions

direct link, or that exposure to RF causes cancer.

Try to put this all in perspective. More than 100 000 people in the UK die each year from smoking. Approximately 20 000 UK citizens die annually from alcohol related illnesses. Even peanut allergies kill 50 members of the British public a year. To the current knowledge of all the scientists in the world, nobody has died as a direct result of the RF radiation emitted from mobile phone technology. Yet headlines such as "16 Masts in Cancer Street" and "Plague of the Phone Masts" often grace the pages of the tabloid newspapers.

In May 2000, the Independent Expert Group on Mobile Phones (IEGMP), chaired by the eminent scientist Sir William Stewart, published their comprehensive review entitled *Mobile Phones and Health*. They concluded:

"... 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 the guidelines."

UV, tanning and solaria

Ultraviolet (UV) tanning beds were introduced into the UK in the 1970s. A cause for concern is their increased use by young people with about 24% of British 16–24 year-olds using sunbeds, and there are a growing number of children under the age of 16 who frequent solaria.

Typically a bed will contain forty 200 W fluorescent tubes plus 12 to 24 smaller 25 W tubes

incorporated between the main tubes within the lid. The tubes emit both UVA (95%) which causes skin aging and UVB (5%) which induces erythema (skin inflammation) and ultimately burns.



More importantly, long term exposure to UV can lead to various forms of skin cancer. About 65 000 cases of skin cancer are reported in the UK each year with 2000 proving to be fatal. Malignant melanoma is now the most common form of cancer in young adults aged between 15 and 34 and it is often fatal. It has been estimated that 100 UK skin cancer deaths per year are attributable to the use of tanning beds.

Overdosing on UV

A recent study by the Photobiology Unit at Ninewells Hospital in Dundee found that 83% of sunbeds tested produced UVB radiation levels that exceeded European standards. The UVB emitted has reportedly increased by a factor of 3 over the last ten years, due to the increasing use of high-powered 'fast-tan' lamps.

Another worrying aspect is the increasing number of unmanned solaria where unsupervised users can purchase as many 'UV tokens' as they wish from a coin-operated machine. Each token switches on the bed for no less than three minutes which, on average, is the maximum recommended UV exposure for un-tanned skin. Six minutes on an average sunbed is enough to induce erythema in people with skin type 2.

Yet vanity prevails. The quest for that 'healthy looking' tan goes on unchecked by a significant proportion of the population who are either

ignorant of the undeniable cancer risks represented by sunbeds or simply chose to ignore them. In addition, both local and national government seem remarkably slow to introduce any legislation or licensing regime to control solaria.

Despite the wealth of scientific data that causally links UV exposure to skin cancer, it seems that the general public are more worried about, and the media more fascinated by, the potential cancer risks from mobile phones than the irrefutable cancer risks due to sunbed usage.

To summarise, and all other things being equal, a tanorexic telephonophobe probably stands a greater risk of developing some form of fatal cancer than a pasty chatterbox with a mobile phone.

BOX 1 Tanning and skin type



The sensitivity of skin to UV exposure depends on many factors. Previous tanning history, ethnic group, medical history and medication are all contributors. The Fitzpatrick scale categorizes skin into 6 'photo-types', with type 1 being the fairest and type 6 being the darkest. It is believed that the majority of solaria clientele fall into the skin type 2 category. Type 2 means fair-skinned Caucasians with poor tanning ability and a susceptibility to sun-burn.

The relationship between UV radiation dose and skin erythema has been thoroughly investigated by the scientific community and is largely understood. Erythematous UV dose is also acknowledged as a surrogate for carcinogenically-effective skin exposure, particularly for Squamous Cell Carcinoma (SCC). In other words, each time your skin goes red, you are increasing your chance of getting skin cancer.

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