

## Public Health, Mobile Phone Masts and Planning Policy

These notes summarise the adverse Public Health effects of radiation from mobile phone masts, and the implications for planning policy.

Four aspects:

- |   |          |
|---|----------|
| (1) Evidence of adverse Public Health effects, human and wildlife     | [page 1] |
| (2) Guidelines for different sensitivities and different durations    | [page 3] |
| (3) National Planning Policy Framework 2019: conflicting requirements | [page 5] |
| (4) Practical Public Health issues in the siting of masts             | [page 6] |
| Notes and references  | [page 8] |

### 1. Evidence of adverse Public Health effects: human and wildlife

(a) Adverse Public Health effects: humans

- **Harmful radiation:** electromagnetic (EM) radiation from mobile phone, TV, radio and TETRA masts and similar antennas causes adverse health effects, according to studies since 1996.
- **80% of these studies** found adverse health effects arising from the radiation from mobile phone masts, according to a review [*Notes §1: Khurana et al, 2010*].
- **Distance:** most surveys find measurable aspects of adverse health within a distance of about 500 metres.
- **Dose-response pattern:** adverse health effects occur in a dose-response pattern, with people living and working closer to the mast having greater adverse health effects.
- **Neurological effects** often include: headaches, fuzzy thinking, memory lapses.
- **DNA damage:** especially significant in females, within 300m of masts, cumulative with mobile phone usage.
- **Cancer risks are increased** by up to five times after about five years' residence within 500 metres.
- **Cancer risk classification:** The radiation from mobile phone masts was classified as a 2B possible human carcinogen by the World Health Organization's IARC in 2011. Many leading experts now state, in peer-reviewed studies, that new evidence after 2011 requires that radio frequency radiation is raised from a 2B cancer classification to 2A probable or 1 certain human carcinogen. See below for some of these studies. [*Notes §2*]  
The reason this has not yet happened is that the World Health Organization (WHO) and the ICNIRP have many conflicts of interest, as explained by Professor L. Hardell, one of the world's leading experts in this field ("The WHO, RF radiation and health - a hard nut to crack," 2017). [*Notes §3*]
- **Other physiological problems from this radiation:** heart problems, skin effects, respiratory problems, diabetic effects, digestive problems, muscular problems, sinus problems, food and other allergies, etc..

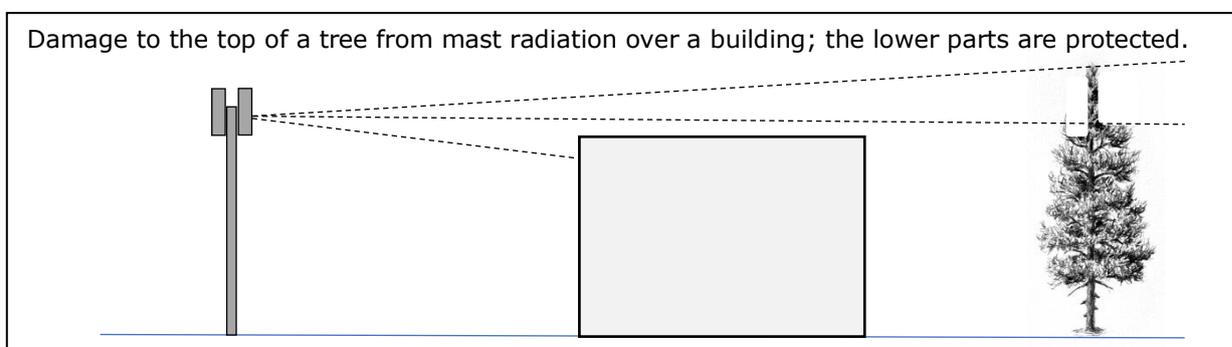
- **Genetic sensitivity to EM energy:** Many of these established adverse health outcomes also relate to specific sensitivity symptoms to this type of radiation, including those who suffer from electromagnetic hyper-sensitivity (EHS). Such people often have specific genetic variations which predispose them to being especially sensitive to this radiation. Some of these genetic haplotypes are in common with those for cancer initiation. Such people may be unable to continue residing or working in proximity to a mast.
- **Implants:** Some people with passive metallic implants can be affected adversely by radiation as from masts. See below, part 4.
- **Studies:** Over 40 studies showing ill health from masts and mobile phone radiation, including cancers and neurological effects, are listed at the end of this paper.

[Notes §4]

(b) *Adverse health effects: plants and wildlife*

- **Harmful radiation:** many studies show that radiation from mobile phone masts has an adverse effect on plants and wildlife.
- **Adverse effects:** destruction of trees, disorientation and some forms of colony collapse in bees, insect and bat reduction, bird reproduction reduced or eliminated, bird migration disorientated, etc..
- **Masts should be banned,** according to leading experts in this field of bioelectromagnetics, to save (i) trees and (ii) birds across the planet.
  - (i) Because trees are always stationary in relation to mast radiation, they suffer more cumulative damage than moving wildlife which is not always exposed in the same place and at the same angle.
  - (ii) Species of birds which rely on migration for breeding may become extinct, if they cannot maintain migratory routes because of the blocking effect of mast radiation on their ability to navigate using the Earth's magnetic field.
- **Studies:** Over 30 studies showing adverse effects on plants and wildlife are listed at the end of this paper.

[Notes §5]



## 2. Guidelines: for different sensitivities and different durations

*(a) People sensitive to electromagnetic energy need low limits (ICNIRP 2002)*

- The ICNIRP (2002), like the US EPA in 1992, warns that people sensitive to EM energy need non-thermal limits below the ICNIRP 1998 Guidelines with their 6-minute heating limits, which are the present limits used by the UK government under NPPF 2019.

*[Notes §6]*

- The UK government says that it follows the ICNIRP.
- Guidelines, which are biological and long-term and thus suitable for sensitive people, include:
  - IGNIR 2018
  - Bioinitiative 2012
  - Building Biology 2008
  - EUROPAEM 2016
  - Seletun 2010

*[Notes §7]*

*(b) Long-term biological guidelines and for sensitive people (e.g. Bioinitiative, Building Biology, EUROPAEM 2016, Seletun)*

- **Long-term limits:** IGNIR, Bioinitiative 2012 (protective for 62 of 67 studies), Building Biology 2008, EUROPAEM EMF Guidelines 2016, and Seletun 2010 are designed for non-thermal long-term exposure, as from masts, unlike ICNIRP 6-minute heating limits.
- **Duration:** the IGNIR and EUROPAEM 2016 limits are calculated for 24-hour exposures, not 6 minutes, but some incorporate up to 4 hours per 24 hours at higher levels of exposure. Such higher exposures may not apply to people who are hyper-sensitive, who need low levels at all times. All people, whether consciously sensitive or not, are affected by cumulative radiation exposures.
- **Sleeping areas:** most experts now regard low levels of radiation in the sleeping area as crucial for allowing the body to recover at night, so any exposure near residential accommodation should comply with these limits.
- **Co-exposures:** people with hyper-sensitivity to EM energy are, in 80% of cases, also hyper-sensitive to chemical pollution, including the effects of airborne pesticides and pesticides on plants and in foods.
- **Sensitive people:** include children, the elderly, the ill, pregnant women, and people who are sensitive or hyper-sensitive to electromagnetic radiation, estimated by the WHO to be about 3% of the general population. Recent studies indicate that about 40% of adults are subconsciously sensitive to this radiation, since it has adverse cellular effects which affect their chronic immune conditions.

*[Notes §7]*

*(c) Short-term 6-minute heating guidelines (ICNIRP 1998)*

- **The ICNIRP 1998 Guidelines:** these guidelines are still used by the UK government both for short-term exposures, as from mobile phones calls, and for long-term exposures, as from radiation zones around mobile phone masts. This means that the UK effectively has no appropriate safety guidelines for long-term exposure and health effects from masts.

- Heating only limits:** these ICNIRP 1998 guidelines are only for preventing the heating of the body by more than one degree averaged over 6 minutes. They are therefore not relevant to long-term non-thermal exposures, such as working or living near a mast.  
 ICNIRP states that "These guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns ... and elevated tissue temperatures resulting from absorption of energy during exposure to EMF" and they do not protect against "long-term effects of exposure, such as an increased risk of cancer".
  - Mistaken thermal hypothesis:** in 1953 Schwan in the USA claimed, mistakenly, that the only adverse effect of radio and microwave exposure is heating. In contrast, in 1958 the USSR correctly recognised established non-thermal effects. The majority of involved scientists now regard ICNIRP's heating of one degree in six minutes as irrelevant, since exercise can easily induce a bodily temperature rise of one degree within six minutes, yet this does not trigger the established neurological and cancer effects caused by radiation such as from masts and mobile phones. Experts now consider that more accurate ways of setting safety limits for the health damage caused by phone mast radiation are DNA breaks and other markers of harmful oxidative stress. These are the basis of biological limits.
  - Natural levels and problems of pulse and modulation:** the natural or 'green' environmental levels relevant to this type of radiation are about 3 to 10 million times below man-made levels of radiation allowed by ICNIRP limits. In addition, natural radiation is not artificially pulsed or modulated, and these two factors are known to exacerbate the adverse health effects of mobile phone radiation.
  - DNA effects:** mobile phone mast radiation has been shown to induce DNA changes which affect fertility, in addition to established neurological and cancer effects. DNA changes thus have teratogenic effects and some studies show extinction of species within five generations at high levels of man-made radiation.
- [Notes §8]

Long-Term and Short-Term Safety Limits						
Electric Field: Volts / metre: V/m						
(Power Density, for heating: micro Watts / metre squared: $\mu\text{W}/\text{m}^2$ )						
Type	Group	Radio Frequency	DAY TIME	NIGHT TIME	SENSITIVE	HOURS
Natural level		RF	0.00002 V/m (0.000001 $\mu\text{W}/\text{m}^2$ )			24/24
Long-term, biological	Bioinitiative 2012	RF	0.04 V/m (6 $\mu\text{W}/\text{m}^2$ )		0.03 V/m (3 $\mu\text{W}/\text{m}^2$ )	24/24
	Building Biology 2008 (Slight Concern)	RF		0.06 V/m (10 $\mu\text{W}/\text{m}^2$ )	0.006 V/m (0.1 $\mu\text{W}/\text{m}^2$ )	Sleeping
	EUROPAEM 2016, IGNIR 2018	Wifi G2.5	0.06 V/m (10 $\mu\text{W}/\text{m}^2$ )	0.019 V/m (1 $\mu\text{W}/\text{m}^2$ )	0.006 V/m (0.1 $\mu\text{W}/\text{m}^2$ )	20/24
		Mobile phone G2,G3,G4	0.19 V/m (100 $\mu\text{W}/\text{m}^2$ )	0.06 V/m (10 $\mu\text{W}/\text{m}^2$ )	0.019 V/m (1 $\mu\text{W}/\text{m}^2$ )	20/24
	Seletun 2010	RF	0.25 V/m (170 $\mu\text{W}/\text{m}^2$ )			24/24
	Long-term Danger Level	RF	above 0.04-0.25 V/m (6-170 $\mu\text{W}/\text{m}^2$ )			24/24
Short-term, heating	ICNIRP 1998	RF	up to 62.0 V/m (10,000,000 $\mu\text{W}/\text{m}^2$ )			(0.1) 24/24

### 3. National Planning Policy Framework 2019: conflicting requirements

- **Planners have two mutually irreconcilable responsibilities** under the NPPF:
  - (a) 'achieve healthy ... places', 'support healthy lifestyles', and 'improve health' within the areas for which the planners are responsible, and as a result of any individual planning decision,
  - (b) 'not set health safeguards' different from the unscientific and obsolete short-term 6-minute heating limits set by the ICNIRP.
- **Individual planners and regulators are being held personally liable**, in increasing numbers of legal cases around the world, where they allow radiation at levels known to cause long-term adverse health effects although compliant with ICNIRP's short-term heating limits, but where they do not also take additional action to ensure and support the health of nearby residents. Such action might include protecting residents from the established long-term effects by shielding individual properties, medical monitoring and other mitigation of the EM pollution.

#### (a) **Planning requirement to ensure and support health (NPPF)**

##### § 2: *Achieving sustainable development:*

- (8) Two of the three interdependent Overarching Objectives require
- (b) a Social Objective: to foster "a well-designed and safe built environment ... that ... support communities' health", and
- (c) an Environmental Objective: to contribute to protecting and enhancing our natural, built and historic environment ... helping to improve biodiversity."

##### § 8: *Promoting healthy and safe communities:*

- (91) "Planning policies and decisions should aim to achieve healthy, inclusive and safe places":
- (c) "enable and support healthy lifestyles, especially where this would address identified local health and well-being needs".
- (92,b) "take into account and support the delivery of local strategies to improve health, social and cultural well-being for all sections of the community"

##### *Open space and recreation:*

- (96) "Access to a network of high quality open spaces and opportunities for sport and physical activity is important for the health and well-being of communities."

##### § 12. *Achieving well-designed places*

- (127) Planning policies and decisions should ensure that developments:
  - f) create places ... which promote health and well-being

#### (b) **Planning requirement not to support or improve health (NPPF)**

##### § 10. *Supporting high quality communications*

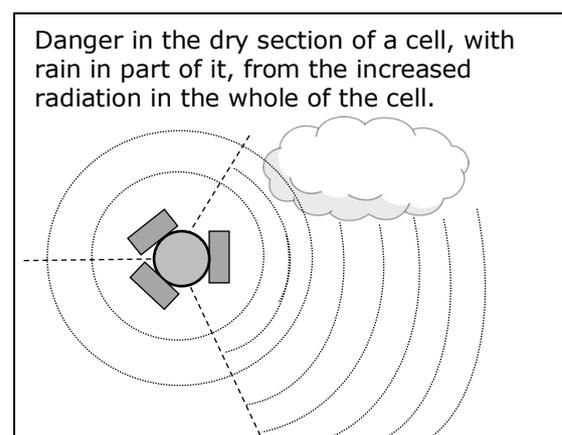
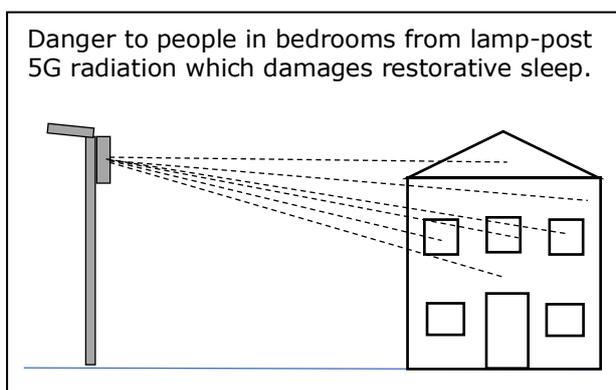
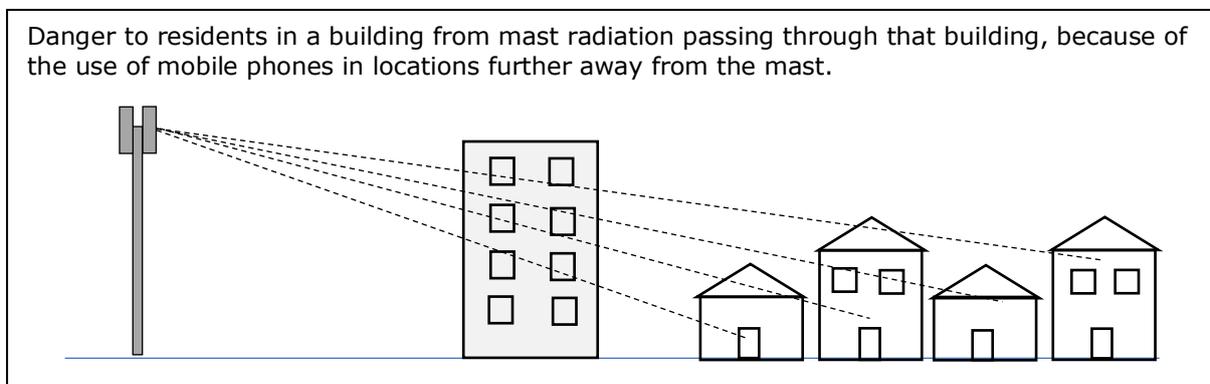
- (112) "Planning policies and decisions should support the expansion of electronic communications networks, including next generation mobile technology (such as 5G) and full fibre broadband connections."
- (116) "Local planning authorities must determine applications on planning grounds only. They should not ... set health safeguards different from the International Commission guidelines for public exposure."

### (c) Practical Public Health issues in the siting of masts

NPPF sections 2, 8 and 12 give planners a responsibility to ensure and support the health of local residents. Planners can help to fulfil this responsibility in part by reference to careful siting and design of masts. Some examples of factors for consideration are given below.

- NB: Many hand-held meters and detectors are available to check compliance with biological limits for mobile phone mast and similar radiation, typically for the range 0.01 V/m (0.3  $\mu\text{W}/\text{m}^2$ ) to 3.0 V/m (24,000  $\mu\text{W}/\text{m}^2$ ). [Notes §10]
  - (a) *Distance*: a minimum distance of 500m from a mast should reduce the risk of cancers and adverse neurological effects for nearby residents.
  - (b) *Sleeping, living and working accommodation*: it is especially important to ensure the appropriate distance from sleeping, living and working accommodation, according to the best health advice.
  - (c) *Areas with sensitive populations*: the location of masts should avoid proximity to areas with especially sensitive populations, such as children, pregnant women, the elderly, people who are ill, and people with EHS. Such locations therefore include hospitals, schools, nurseries, nursing homes, old-people's homes, residential housing, playgrounds, etc.
  - (d) *Density of masts and antennas*: it is essential to avoid high densities of masts and antennas, which thus create much higher levels of radiation, especially near
    - (i) town and urban areas, where multiple masts and multiple wifi systems create high levels of electrosmog, with all their known health effects, especially when combined with domestic and personal sources of radiation,
    - (ii) transport routes, where driver fatigue, lack of concentration and disorientation can have adverse effects,
  - (e) *Cumulative effects*: there are higher risks where mast radiation is present in proximity to fixed transmitters, such as wireless smart meters and Wifi installations. It is helpful if councils or other authorities check compliance with biological limits, such as EUROPAEM 2016, in these situations.
  - (f) *Radiation patterns*: care is needed in siting masts so that radiation is not unduly concentrated in areas just over, or around, fixed features or obstacles, such as large buildings and steep hills.  
Alternatively, careful location of masts can use topographical features, like road or railway embankments, to help protect residential housing beyond these features from the full strength of the radiation.
  - (g) '*Green*' or '*White*' zones free of man-made radiation or [EQZ](#): areas free of man-made radiation were recommended by the Council of Europe in 2011 to help enable people sensitive to this type of radiation to live full lives within communities: "*special measures to protect them, including the creation of wave-free areas not covered by the wireless network*".  
[Notes §11]

- (h) *Active implants, such as pacemakers:* these should not be a problem if they are designed by manufacturers to withstand most likely locations with current levels of environmental EM radiation. Combined exposures or new technologies, however, like 5G antennas on lamp-posts outside bedrooms, may present challenges until systems are adapted.
- (i) *Passive metallic implants, including mercury in dental amalgam restorations,* can be problematic
  - (i) in inducing internal electric currents, which can cause suffering in people who are highly sensitive,
  - and (ii), in the case of mercury amalgams, in releasing mercury within the body, as well as inducing currents.
 Many countries have long phased out mercury for dental restorations.
- (j) *Weather conditions:* in areas with high rainfall and misty conditions, mobile phones masts more often switch to higher levels of radiation to overcome the attenuation of their signals caused by the water droplets in the atmosphere. This usually means that within the arc of a single cell, any area not directly in the rainstorm suffers significantly higher levels of radiation. Planners need, therefore, to allow for this in ensuring the distance necessary from residential accommodation to help safeguard residents' health.
- (k) *Long-term solutions:* when NPPF paragraph 46 is changed or when the ICNIRP changes to long-term limits, planners will be able to act in accordance with their responsibility for health. Fibre optic cables can deliver high-speed internet access to each home and work-place.



## NOTES AND REFERENCES

### 1. Review of studies, with 80% of studies showing ill health from masts:

- Khurana VG et al.: "Epidemiological evidence for a health risk from mobile phone base stations" *Int J Occup Environ Health*. (2010) [PMID: 20662418](#).

### 2. Studies showing sufficient evidence for phone mast radiation to be reclassified, from the existing Class 2B Possible, to Class 2A Probable, or to Class 1 Certain, Human Carcinogen:

- Carlberg M et al.: "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation" *Biomed Res Int*. (2017) [PMID: 28401165](#). [PMC5376454](#).
- Davis DL et al.: "Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen" *Pathophysiology*. (2013) [PMID: 23664410](#).
- Hardell L et al.: "Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones" *Rev Environ Health*. (2013) [PMID: 24192496](#).
- Morgan LL et al.: "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (Review)" *Int J Oncol*. (2015) [PMID: 25738972](#).

### 3. World Health Organization/ICNIRP in confusion and conflict of interests over wireless radiation:

- Hardell L: "World Health Organization, radiofrequency radiation and health – a hard nut to crack (Review)" *Int J Oncology*. (2017) [PMID: 28656257](#). [PMC5504984](#).

### 4. Studies showing human ill health near masts:

- Abdel-Rassoul G et al.: "Neurobehavioral effects among inhabitants around mobile phone base stations" *Neurotoxicology* (2007) [PMID: 16962663](#).
- Aschermann C: "Electrosensitivity: A patient with Burn-like Skin Manifestations" *Umwelt-Medizin-Gesellschaft*. (2011) [pdf \(trans\)](#).
- Aschermann C: "Observations from a Psychotherapy Practice on Mobile Telecommunications and DECT Telephones" *Umwelt-Medizin-Gesellschaft*. (2004; rev. 2009) [pdf \(trans\)](#).
- Aschermann C: "Personality changes caused by mobile telecommunications" *Umwelt-Medizin-Gesellschaft*. (2010) [pdf \(trans\)](#).
- Bise W: "Low power radio-frequency and microwave effects on human electroencephalogram and behaviour" *Physiol Chem Phys*. (1978) [PMID: 751078](#).
- Blettner N et al.: "Mobile phone base stations and adverse health effects: phase 1 of a population-based, cross-sectional study in Germany" *Occup Environ Med*. (2009) [PMID: 19017702](#).
- Borkiewicz A et al.: "Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review" (Polish) *Med Pr*. (2004) [PMID: 15620045](#).
- Borkiewicz A et al.: "Heart rate variability (HRV) analysis in radio and TV broadcasting stations workers" *Int J Occup Med Environ Health*. (2012) [PMID: 23224733](#).
- Buchner K et al.: "Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields - A Long-term Study under Real-life Conditions" *Umwelt-Medizin-Gesellschaft* (2011) ([copy](#)).
- Eger H et al.: "Einfluss der räumlichen Nähe von Mobilfunksendeanlagen auf die Krebsinzidenz" [Influence of the spatial proximity of mobile radio stations to the incidence of cancer] *Umwelt-Medizin-Gesellschaft*. (2004) [summary](#).
- Eger H et al.: "Specific Health Symptoms and Cell Phone Radiation in Selbitz, Bavaria, Germany - Evidence of a Dose-Response Relationship" *Umwelt Medizin Gesellschaft* (2010) [article in trans](#).
- Eskander EF et al.: "How does long term exposure to base stations and mobile phones affect human hormone profiles?" *Clin Biochem*. (2012) [PMID: 22138021](#).
- Gandhi G et al.: "A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station" *Electromagn Biol Med*. (2015) [PMID: 25006864](#).
- Ghosh PM et al.: "A Review of the Potential Health Hazards of Radio Frequency Radiation from Cellular Base Station" *Brit J Appl Sci Techn*. (2017) [Article](#).
- Gomez-Perretta C et al: "Subjective symptoms related to GSM radiation from mobile phone base stations: a cross-sectional study" *BMJ Open* (2013) [PMID: 24381254](#); [pdf](#).
- Gulati S et al.: "Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers" *Mol Cell Biochem*. (2017) [PMID: 28819931](#).
- Hallberg Ö et al.: "Alzheimer mortality - why does it increase so fast in sparsely populated areas?" *Europ Biol Bioelectromag*. (2005) [pdf](#).
- Hocking B et al.: "Decreased survival for childhood leukemia in proximity to television towers" *Arch Environ Health*. (2003) [PMID: 15369273](#).

- Houshyari M et al.: "Incidence of Seminoma Cancer in Staffs that Worked in Electromagnetic Waves Station; Three Cases Report" *Iran J Cancer Prev.* (2015) [PMID: 25821575](#); [pdf](#).
  - Huss A et al.: "Environmental Radiofrequency Electromagnetic Fields Exposure at Home, Mobile and Cordless Phone Use, and Sleep Problems in 7-Year-Old Children" *PLoS One.* (2015) [PMID: 26509676](#).
  - Hutter H et al.: "Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations" *Occup Environ Med.* (2006) [PMID: 16621850](#).
  - Huttunen P et al.: "Involuntary human hand movements due to FM radio waves in a moving van" *Acta Physiol Hung.* (2011) [PMID: 21616774](#).
  - Khurana VG et al.: "Epidemiological evidence for a health risk from mobile phone base stations" *Int J Occup Environ Health* (2010) [PMID: 20662418](#).
  - Kolodynski AA, Kolodynska W: "Motor and psychological functions of school children living in the area of the Skruna Radio Location Station in Latvia" *Sci Total Environ.* (1996) [PMID: 8717320](#).
  - Kundi M et al.: "Mobile phone base stations-Effects on wellbeing and health" *Pathophysiology.* (2009) [PMID: 19261451](#).
  - Levitt B et al.: "Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays" *Environ Rev.* (2010) [Article](#).
  - Liu J: "[Hazards of radio frequency magnetic field and their prevention and control]" *Wei Sheng Yan Jiu.* (2002) [PMID: 12572370](#).
  - Navarro EA et al.: "The microwave syndrome: a preliminary study in Spain" *Electromagnetic Biol Med.* (2003) [abstract](#).
  - Parsaei H et al.: "A Multilayer Perceptron Neural Network-Based Model for Predicting Subjective Health Symptoms in People Living in the Vicinity of Mobile Phone Base Stations" *Ecopsychology.* (2017) [link](#); [pdf](#).
  - Preece AW et al.: "Health response of two communities to military antennae in Cyprus" *Occup Environ Med.* (2007) [PMID: 17259164](#).
  - Santini R et al.: "Survey study of people living in the vicinity of cellular phone base stations" *Electromagn Biol Med.* (2003) [article](#).
  - Santini R et al.: "Investigation on the health of people living near mobile telephone relay stations: I. Incidence according to distance and sex" *Pathol Biol. (Paris)* (2002) [PMID: 12168254](#).
  - Santini R et al.: "Symptoms experienced by people in the vicinity of base stations: II. Incidence of age, duration of exposure, location of subjects in relation to the antennas and other electromagnetic factors" *Pathol Biol.(Paris)* (2003) [PMID: 12948762](#).
  - Shahbazi-Gahrouei D: "Base Transceiver Station Antennae Exposure and Human Health" *Int J Prev Med.* (2017) [PMID: 29114375](#). [PMC5651665](#).
  - Shahbazi-Gahrouei D et al.: "Health effects of living near mobile phone base transceiver station (BTS) antennae: a report from Isfahan, Iran" *Electromagn Biol Med.* (2014) [PMID: 23781985](#).
  - Shinjyo T: [Signifikanter Rückgang klinischer Symptome nach Senderabbau – eine Interventionsstudie] "Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal –An Intervention Study" *Umwelt-Medizin-Gesellschaft.* (2014) [copy](#).
  - Singh K et al.: "Effect of electromagnetic radiations from mobile phone base stations on general health and salivary function" *J Int Soc Prev Community Dent.* (2016) [PMID: 27011934](#).
  - Sorgucu U et al.: "Measurement and analysis of electromagnetic pollution generated by GSM-900 mobile phone networks in Erciyes University, Turkey" *Electromagn Biol Med.* (2012) [PMID: 22676177](#).
  - Suvorov IM: "[Clinical monitoring in areas of exposure to radiofrequency electromagnetic fields]" *Med Tr Prom Ekol.* (2013) [PMID: 23785812](#).
  - Taheri M et al.: "The effect of Base Transceiver Station waves on some immunological and hematological factors in exposed persons" *Hum Antibodies.* (2017) [PMID: 27911288](#).
  - Tuysuz B et al.: "Measurement and mapping of the GSM-based electromagnetic pollution in the Black Sea region of Turkey" *Electromagn Biol Med.* (2017) [PMID: 27463094](#).
  - Zinelis SA: "Short-term exposure to mobile phone base station signals" *Environ Health Perspect.* (2008) [PMID: 18288295](#); [article](#).
  - Zothansiana et al.: "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations" *Electromagn Biol Med.* (2017) [PMID: 28777669](#).
  - Zwamborn APM et al.: "Effects of Global Communication System Radio-Frequency Fields on Well-being and Cognitive Functions of Human Subjects with and without Subjective Complaints" *Netherlands Organisation for Applied Scientific Research (TNO)* (2003) [pdf](#).
- 5. Studies showing adverse effects on plants and wildlife near masts:**
- Cucurachi S et al.: "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)" *Environ Int.* (2013) [PMID: 23261519](#).

- Engels S et al.: "Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird" *Nature*. (2014) [PMID: 24805233](#).
- Favre D: "Disturbing Honeybees' Behavior with Electromagnetic Waves: a Methodology" *J Behav*. (2017); [pdf](#).
- Grémeaux A et al: "Low-amplitude, high-frequency electromagnetic field exposure causes delayed and reduced growth in Rosa hybrid" *J Plant Physiol*. (2016) [PMID: 26643955](#).
- Haggerty K: "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations" *Int J Forestry Res*. (2010) <http://dx.doi.org/10.1155/2010/836278>.
- Halgamuge MN: "Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants" *Electromagn Biol Med*. (2017) Review. [PMID: 27650031](#).
- Harst W et al.: "Can Electromagnetic Exposure Cause a Change in Behaviour? Studying Possible Non-Thermal Influences on Honey Bees – An Approach within the Framework of Educational Informatics" *Acta Systemica*. (2006) [pdf](#).
- Hässig M et al.: [Increased occurrence of nuclear cataract in the calf after erection of a mobile phone basestation] *Schweiz Arch Tierheilkd*. (2012) [PMID: 22287140](#). DOI: [10.1024/0036-7281/a000300](#).
- Hässig M et al.: "Prevalence of nuclear cataract in Swiss veal calves and its possible association with mobiletelephone antenna base stations" *Schweiz Arch Tierheilkd*. (2009) [PMID: 19780007](#). [Article](#).
- Hiscock HG et al.: "Disruption of Magnetic Compass Orientation in Migratory Birds by Radiofrequency Electromagnetic Fields" *Biophys J*. (2017) [PMID: 28978441](#). [PMC5627152](#).
- Landler L et al.: "Spontaneous magnetic alignment by yearling snapping turtles: rapid association of radio frequency dependent pattern of magnetic input with novel surroundings" *PLoS One*. (2015) [PMID: 25978736](#). [PMC4433231](#).
- Malkemper EP et al.: "Magnetoreception in the wood mouse (*Apodemus sylvaticus*): influence of weak frequency-modulated radio frequency fields" *Sci Rep*. (2015) [PMID: 25923312](#). [PMC4413948](#).
- Margaritis LH et al: "Drosophila oogenesis as a bio-marker responding to EMF sources" *Electromagn Biol Med*. (2014) [PMID: 23915130](#).
- Mina D et al: "Immune responses of a wall lizard to whole-body exposure to radiofrequency electromagnetic radiation" *Int J Radiat Biol*. (2016) [PMID: 26853383](#).
- Panagopoulos DJ et al: "Mobile Telephony Radiation Effects on Living Organisms" in: Harper AC et al (edd.) (2008) "Mobile Telephones: Networks, Applications and Performance" (2008) *Nova Science Pub.*; [article](#).
- Pall ML: "Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor" *Curr Chem Biol*. (2016) [article](#).
- Panagopoulos DJ et al.: "Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna" *Int J Radiat Biol*. (2010) [PMID: 20397839](#).
- Panagopoulos DJ et al.: "Effect of GSM 900-MHz mobile phone radiation on the reproductive capacity of *Drosophila melanogaster*" *Electromagn Biol Med*. (2004) [doi.org/10.1081/JBC-120039350](http://doi.org/10.1081/JBC-120039350).
- Panagopoulos DJ et al.: "The effect of exposure duration on the biological activity of mobile telephony radiation" *Mutat Res*. (2010) [PMID: 20399887](#).
- Panagopoulos DJ et al.: "Cell death induced by GSM 900-MHz and DCS 1800-MHz mobile telephony radiation" *Mutat Res*. (2007) [PMID: 17045516](#).
- Pawlak K et al.: "Plasma thyroid hormones and corticosterone levels in blood of chicken embryos and post hatch chickens exposed during incubation to 1800 MHz electromagnetic field" *Int J Occup Med Environ Health*. (2014) [PMID: 24488772](#). DOI: [10.2478/s13382-014-0222-7](#).
- Qureshi ST et al.: "Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (*Cicer arietinum* L.) root tip cells" *Saudi J Biol Sci*. (2017) [PMID: 28490961](#). [PMC5415122](#).
- Rahmani A et al: "Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees" *Ministry of Environment & Forest, Government of India*; (2011) 88 pages; [pdf](#).
- Sagioglou NE et al: "Apoptotic cell death during *Drosophila* oogenesis is differentially increased by electromagnetic radiation depending on modulation, intensity and duration of exposure" *Electromagn Biol Med*. (2016) [PMID: 25333897](#).
- Schwarze S et al.: "Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (*Erithacus rubecula*) than Strong Narrow-Band Fields" *Front Behav Neurosci*. (2016) [PMID: 27047356](#); [PMC4801848](#).
- Sharma VP et al: "Changes in honeybee behaviour and biology under the influence of cellphone radiations" *Curr Sci*. (2010) [article](#).
- Soran ML et al: "Influence of microwave frequency electromagnetic radiation on terpene emission and content in aromatic plants" *J Plant Physiol*. (2014) [PMID: 25050479](#).
- Stefi AL et al.: "The aftermath of long-term exposure to non-ionizing radiation on laboratory cultivated pine plants (*Pinus halepensis* M.)" *Flora*. (2017) [abstract](#).

- Stefi AL et al.: "The effect of the non-ionizing radiation on exposed, laboratory cultivated upland cotton (*Gossypium hirsutum* L.) plants" *Flora*. (2017) [abstract](#).
- Tomanova K et al.: "The magnetic orientation of the Antarctic amphipod *Gondogeneia antarctica* is cancelled by very weak radiofrequency fields" *J Exp Biol*. (2016) [PMID: 27026715](#). DOI: [10.1242/jeb.132878](#).
- Vácha M et al.: "Radio frequency magnetic fields disrupt magnetoreception in American cockroach" *J Exp Biol*. (2009) [PMID: 19837889](#). DOI: [10.1242/jeb.028670](#).
- Vian A et al.: "Plant Responses to High Frequency Electromagnetic Fields" *Biomed Res Int*. (2016) [PMID: 26981524](#). [PMC4769733](#).
- Waldmann-Selsam C et al: "Tree damage in the vicinity of mobile phone base stations" *Umwelt-medizin-gesellschaft*. (2013); (trans.) [pdf](#).
- Waldmann-Selsam C et al: "Radiofrequency radiation injures trees around mobile phone base stations" *Sci Total Environ*. (2016) [PMID: 27552133](#).
- Waldmann-Selsam C et al: "Trees in Bamberg and Hallstadt in the radiation field of 65 mobile phone base stations: Examples from a documentation about 700 trees (2006-2016)" *Sci Total Environ*. (2016) [pdf](#).
- Wiltschko R et al.: "Magnetoreception in birds: the effect of radio-frequency fields" *J R Soc Interface*. (2015) [PMID: 25540238](#).

#### Reports on wildlife damage from masts:

- Mark Broomhall: "[Report detailing the exodus of species from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period \(2000-2015\)](#)" (Report for the United Nations Educational Scientific and Cultural Organization (UNESCO) And International Union for the Conservation of Nature (IUCN), 2017; 39 pages)
- Helmut Breunig: "[Tree damage caused by mobile phone base stations: An observation guide](#)" (Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V., 2017, 29 pages)
- Diana Kordas: "[Birds and Trees of Northern Greece: Changes since the Advent of 4G Wireless](#)" (2017; 45 pages)

#### 6. ICNIRP's warning that sensitive people need limits below 1998 ICNIRP heating limits:

- ICNIRP (International Commission on Non-Ionizing Radiation Protection) (2002) "General approach to protection against non-ionizing radiation" *Health Phys*. 82(4): 540-548; [PMID: 11906144](#); [article](#).

#### 7. Long-term biological guidelines:

- [IGNIR](#) (International Guidelines on Non-Ionising Radiation); [EQZ](#)
- Bionitiative Report 2012: <http://www.bioinitiative.org/>
- Building Biology 2008 (Sleeping areas): <https://www.baubiologie.de/downloads/building-biology-guidelines-english.pdf>
- Seletun 2010:  
Fragopoulou A et al.: "Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales" *Rev Environ Health*. (2010) [PMID: 21268443](#); [pdf](#).
- EUROPAEM EMF Guidelines 2016:  
Abstract and link to PDF:  
<https://www.degruyter.com/view/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.xml>  
Table 3 (RF limits):  
[https://www.degruyter.com/table/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.xml?id=j\\_reveh-2016-0011\\_tab\\_003](https://www.degruyter.com/table/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.xml?id=j_reveh-2016-0011_tab_003)  
Table 4 ( $\mu\text{W}/\text{m}^2$  and V/m conversions):  
[https://www.degruyter.com/table/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.xml?id=j\\_reveh-2016-0011\\_tab\\_004](https://www.degruyter.com/table/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.xml?id=j_reveh-2016-0011_tab_004)

#### 8. ICNIRP 6-minute heating limits, 1998:

"These guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns ... and elevated tissue temperatures resulting from absorption of energy during exposure to EMF"  
and they do not protect against "long-term effects of exposure, such as an increased risk of cancer".

- ICNIRP: "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)" *Health Phys*. (1998) [PMID: 19667809](#). [article](#).

**Criticism of ICNIRP's 6-minute heating limits as not protective for long-term exposure and not protective against established non-thermal adverse effects:**

- Grigoriev Y: "Methodology of Standards Development for EMF RF in Russia and by International Commissions: Distinctions in Approaches" in Markov M (ed.) (2017) *Dosimetry in Bioelectromagnetics* (2017) ISBN: 978-1498774130; [pdf](#).
- Hardell L et al.: "Biological effects from electromagnetic field exposure and public exposure standards" *Biomed Pharmacother.* (2008) [PMID: 18242044](#).
- Hensinger P et al.: "Wireless communication technologies: New study findings confirm risks of nonionizing radiation" *umwelt-medizin-gesellschaft.* (2016) [pdf](#).
- Markov M et al.: "Protect children from EMF" *Electromagn Biol Med.* (2015) [PMID: 26444201](#).
- Pall ML: "Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action" *Rev Environ Health.* (2015) [PMID: 25879308](#).
- Panagopoulos DJ et al.: "Evaluation of specific absorption rate as a dosimetric quantity for electromagnetic fields bioeffects" *PLoS One.*(2013) [PMID: 23750202](#).
- Redmayne M: "International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)" *Electromagn Biol Med.* (2015) [PMID: 26091083](#).
- Starkey SJ: "Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation" *Rev Environ Health.* (2016) [PMID: 27902455](#); [pdf](#).

**9. National Planning Policy Framework (NPPF):**

- National Planning Policy Framework Feb. 19 2019 Department for Communities and Local Government [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/810197/NPPF\\_Feb\\_2019\\_revised.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf) (Other UK government statements also rely on the ICNIRP's invalidated 1953 heating hypothesis: [NHS 2016](#); [Ofcom 2010](#); [PHE 2013](#); [HSE undated](#); in contrast HSE's [Guide to EMF at Work Regulations](#) for employers includes pregnant women within the category of people 'at particular risk'.)

**10. Some hand-held Meters and Detectors for measuring mobile phone mast radiation:**

- The key reading is peak Volts per metre (V/m) for the E (electric) field.
- Power density ( $\mu\text{W}/\text{m}^2$ ) is relevant to heating measurements.
- Conversion [Table](#). This [converter](#) shows V/m and  $\mu\text{W}/\text{m}^2$ ,  $\text{W}/\text{m}^2$  and  $\text{mW}/\text{cm}^2$ .
- [Acousticom 2](#) (lowest reading 0.01 V/m = 0.3  $\mu\text{W}/\text{m}^2$ ) changes from green lights to yellow at 0.05 V/m (6  $\mu\text{W}/\text{m}^2$ ), to amber at 0.3 V/m (240  $\mu\text{W}/\text{m}^2$ ) and to red at 3.0 V/m (24,000  $\mu\text{W}/\text{m}^2$ ).
- [Acoustimeter AM-10](#) (lowest reading 0.02 V/m = 1  $\mu\text{W}/\text{m}^2$ ) changes from green lights to yellow at 0.07 V/m (13  $\mu\text{W}/\text{m}^2$ ) and to red at 0.5 V/m (700  $\mu\text{W}/\text{m}^2$ ).
- [Cornet ED78S](#) (lowest reading 0.014 V/m = 0.5  $\mu\text{W}/\text{m}^2$ ) changes from green lights to yellow at -30 dBm = 580  $\mu\text{W}/\text{m}^2$  [0.21 V/m], and to red at -15 dBm = 180,000  $\mu\text{W}/\text{m}^2$  [1.2 V/m].
- [RadAware](#) *Most sensitive setting:* (lowest reading 0.015 V/m = 0.6  $\mu\text{W}/\text{m}^2$ ) changes from green lights to yellow at 0.0375 V/m (3.78  $\mu\text{W}/\text{m}^2$ ) and to red at 0.09 V/m (21.6  $\mu\text{W}/\text{m}^2$ ). *Least sensitive setting:* (lowest reading 0.3 V/m = 240  $\mu\text{W}/\text{m}^2$ ) changes from green lights to yellow at 0.75 V/m (1,512  $\mu\text{W}/\text{m}^2$ ) and to red at 1.8 V/m (8,640  $\mu\text{W}/\text{m}^2$ ).
- [3-x Axis RF Meter](#) (lowest reading 0.038 V/m = 3.8  $\mu\text{W}/\text{m}^2$ ; highest 11 V/m = 30,000  $\mu\text{W}/\text{m}^2$ )

**11. European Resolutions:**

- Council of Europe: [Resolution 1815](#) (Parliamentary Assembly, 2011) Point 8.1.4: "Pay particular attention to 'electrosensitive' people who suffer from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network."
- European Union: [Parliamentary Resolution \(2008/2211\(INI\)\)](#) (2009) Point 28: "Calls on Member States to follow the example of Sweden and to recognise persons that suffer from electrohypersensitivity as being disabled so as to grant them adequate protections as well as equal opportunities."

**12. Further Sources, 5G:**

"[Selected Studies on Electrosensitivity \(ES\) and EHS](#)" (ES-UK, 2018).  
 Prof. G Kumar: "[Cellphone/Tower Radiation Hazards and Solutions](#)" (2017). [Mast Action](#).  
[5G Appeal](#) to halt 5G; [Stop 5G on Earth and in Space](#) (International Appeal, over 150,000 signatories)  
[Serious flaws in the WHO's and ICNIRP's claims on 5G and RF wireless radiation](#) (2019)  
[RF and ELF Biological Effects. Majority and Minority Viewpoints and Guidelines](#) (2019)

Michael Bevington, 2019