Mobile phones, wireless communication and health – the Evidence

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1

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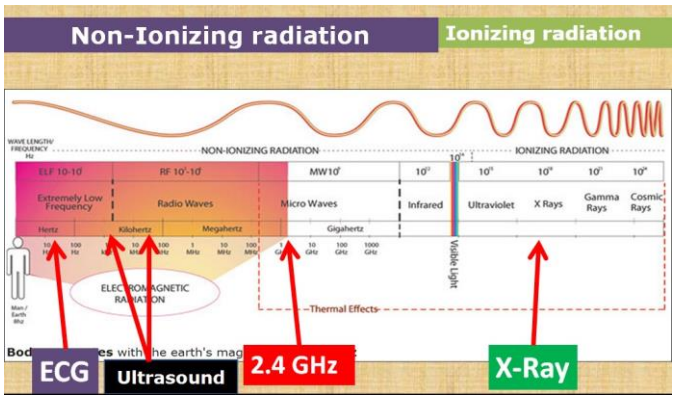
2



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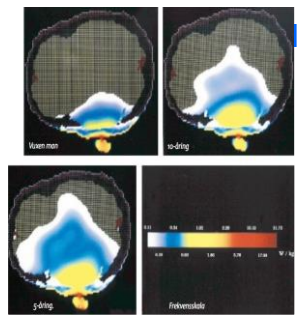
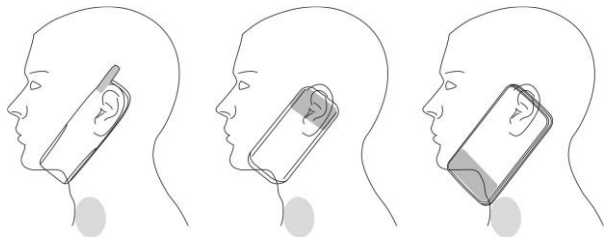


Adult man, 10 years child, 5 years child, frequency scale.

GSM phone 835 MHz with SAR in Watt/kg.

Professor Om Gandhi with courtesy.

4



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World Health Organization

IARC/WHO risk evaluation, 2011:

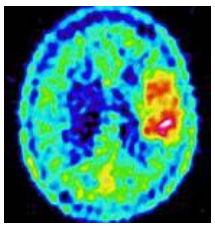
The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency (RF) electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, and **acoustic neuroma** associated with **wireless radiation**

http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

(All sources for radiation in the frequency range 30 kHz–300 GHz)

6

GLIOMA	Ipsilateral		
	Cases/controls Numbers of exposed	Odds Ratio	95 % Confidence Interval
Interphone 2010			
Cumulative use ≥1,640 h	100/62	1.96	1.22 – 3.16
Coureau et al 2014			
Cumulative use ≥896 h	9/7	2.11	0.73 – 6.08
Hardell, Carlberg 2015			
Cumulative use ≥1,640 h	138/133	3.11	2.18 – 4.44
Meta-analysis			
Cumulative use ≥1,640 h*	247/202	2.54	1.83 – 3.52



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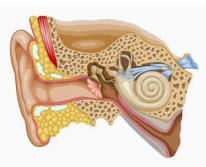
Acoustic neuroma	Ipsilateral		
	Cases/controls Numbers of exposed	OddsRatio	95 % Confidence Interval
Interphone 2010			
Cumulative use ≥1,640 h	47/46	2.33	1.23 – 4.40
Hardell et al 2013			
Cumulative use ≥1,640 h	19/133	3.18	1.65 – 6.12
Meta-analysis			
Cumulative use ≥1,640 h	66/179	2.71	1.72 – 4.28



8

Pathology findings – Brain

Hyperplastic Brain Lesions in Male Rats

	Control	GSM Modulation			CDMA Modulation		
	0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg
Number examined	90	90	90	90	90	90	90
Malignant glioma‡	0*	3 (3.3%)	3 (3.3%)	2 (2.2%)	0	0	3 (3.3%)
Glial cell hyperplasia	0	2 (2.2%)	3 (3.3%)	1 (1.1%)	2 (2.2%)	0	2 (2.2%)

‡ Historical control incidence in NTP studies: 11/550 (2.0%), range 0-8%

* Significant SAR-dependent trend for CDMA exposures by poly-6 ($p < 0.05$)

9

Pathology findings – Schwannomas

Schwannomas Observed in Male Rats

	Control	GSM Modulation			CDMA Modulation		
	0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg	1.5 W/kg	3.0 W/kg	6.0 W/kg
Number examined	90	90	90	90	90	90	90
Heart‡	0*	2 (2.2%)	1 (1.1%)	5 (5.5%)	2 (2.2%)	3 (3.3%)	6** (6.6%)
Other sites	3 (3.3%)	1 (1.1%)	4 (4.4%)	2 (2.2%)	2 (2.2%)	1 (1.1%)	2 (2.2%)
All sites (total)	3 (3.3%)	3 (3.3%)	5 (5.5%)	7 (7.7%)	4 (4.4%)	4 (4.4%)	7 (7.7%)

‡ Historical control incidence in NTP studies: 9/699 (1.3%), range 0-6%

* Significant SAR-dependent trend for GSM and CDMA exposures by poly-3 ($p < 0.05$)

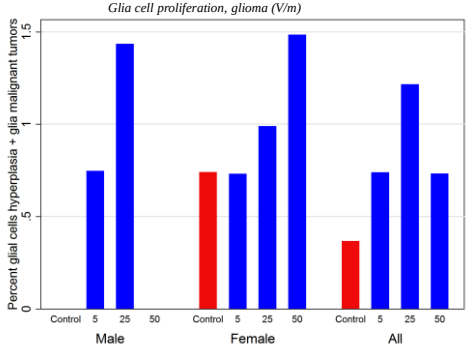
** Significant different than controls poly-3 ($p < 0.05$)

24

10

Ramazzini Institute Italy Rat Study

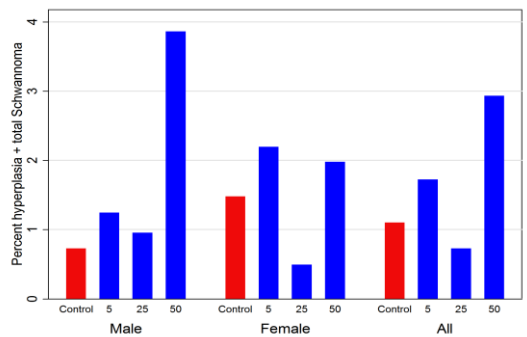
Glia cell proliferation, glioma (V/m)



11

Ramazzini Institute Italy Rat Study

Schwann cell proliferation + Schwannoma ('acusticus neurinoma') V/m



12

ICNIRP Note: Critical evaluation of two radiofrequency electromagnetic field animal carcinogenicity studies published in 2019. Health Phys 118(00), 2020

- No verified mechanism for RF radiation carcinogenesis

But:

-oxidative stress

-DNA damage

- Histopathology evaluation was not blinded
- Increased body temperature in NTP = the cancer risk
- Only Hardell group showed increased acoustic neuroma risk

-Note similar findings in Interphone

- Ignores the concordance between the tumour types found in human epidemiology and animal studies.

13

ICNIRP Commission

Rodney Croft, chair
Maria Feychting, vice chair
Adèle C. Green, MD
Akimasa Hirata
Guglielmo d'Inzeo
Carmela Marino
Sharon Miller
Gunnhild Oftedal
Tsutomu Okuno
Eric van Rongen
Martin Röösli
Zenon Sienkiewicz
Soichi Watanabe

14

Karipidis K*, Elwood M, Benke G, Sanagou M, Tjong L, Croft RJ*. Mobile phone use and incidence of brain tumour histological types, grading or anatomical location: a population-based ecological study.
BMJ Open. 2018 Dec 9;8(12):e024489. doi: 10.1136/bmjopen-2018-024489.
***ICNIRP**

-glioblastoma (GBM) incidence increased significantly only during the period 1993-2002 (1982-2013)
-increase in frontal lobe
-ages 20-59. This represents about 39% of Australian brain tumours
-age-standardised to WHO world standard population, which in no way represents the modern Australian population age-spectrum

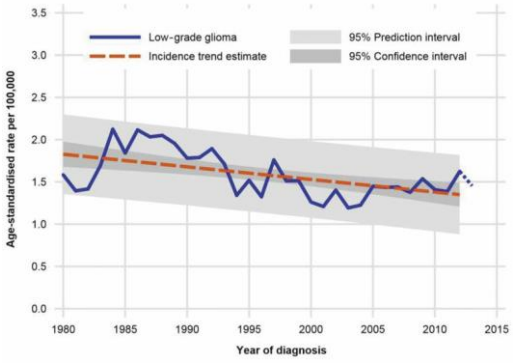
15

Nilsson J, Järås J, Henriksson R, Holgersson G, Bergström S, Estenberg J*, Augustsson T*, Bergqvist M. No Evidence for Increased Brain Tumour Incidence in the Swedish National Cancer Register Between Years 1980-2012. Anticancer Res. 2019 Feb;39(2):791-796.
***SSM (Swedish Radiation Protection Agency) relies on ICNIRP**

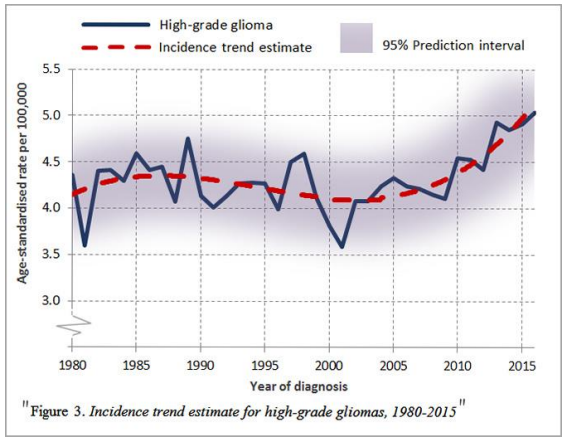
Note ended in 2012

Data on high grade glioblastoma (GBM) not presented

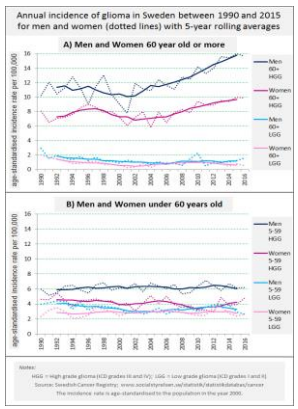
16


Low-grade glioma
Incidence trend estimate
95% Prediction interval
95% Confidence interval
Age-standardised rate per 100,000
Year of diagnosis

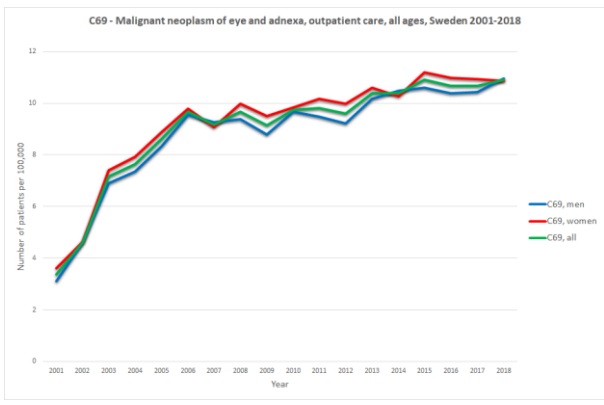
17


High-grade glioma
Incidence trend estimate
95% Prediction interval
Age-standardised rate per 100,000
Year of diagnosis
"Figure 3. Incidence trend estimate for high-grade gliomas, 1980-2015"

18


Annual incidence of glioma in Sweden between 1990 and 2015
for men and women (dotted lines) with 5-year rolling averages
A) Men and Women 60 year old or more
B) Men and Women under 60 years old

19


C69 - Malignant neoplasm of eye and adnexa, outpatient care, all ages, Sweden 2001-2018
Number of patients per 100,000
Year
C69, men
C69, women
C69, all

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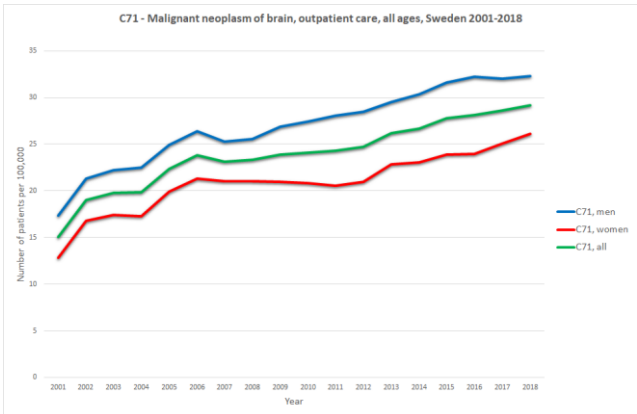
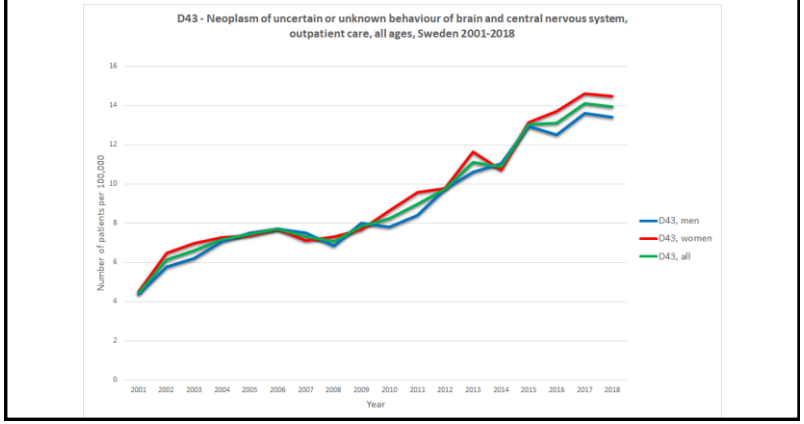
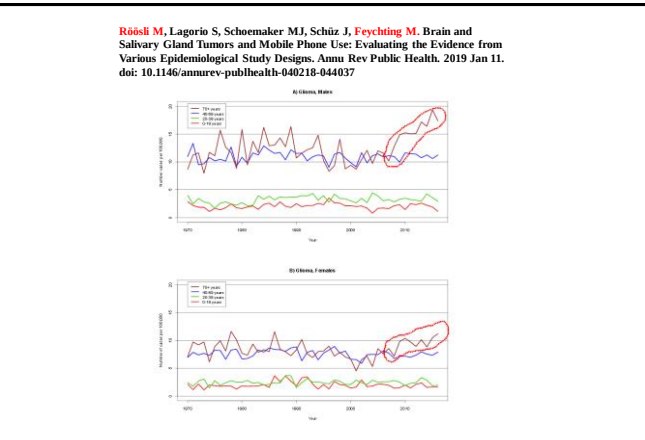

C71 - Malignant neoplasm of brain, outpatient care, all ages, Sweden 2001-2018
Number of patients per 100,000
Year
C71, men
C71, women
C71, all

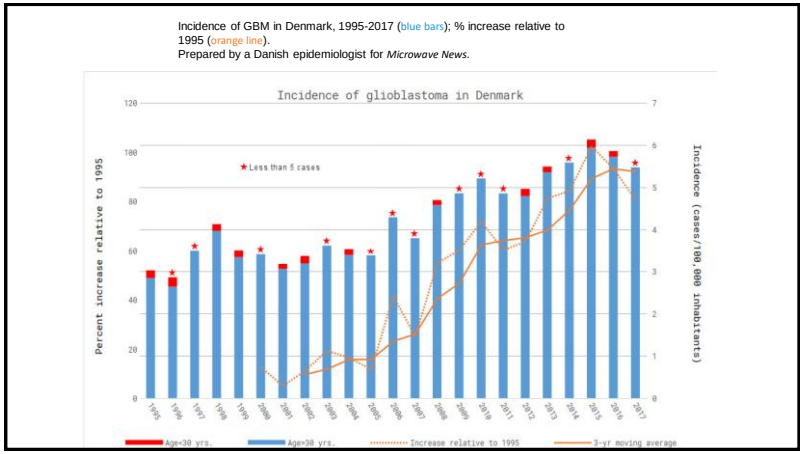
21


D43 - Neoplasm of uncertain or unknown behaviour of brain and central nervous system, outpatient care, all ages, Sweden 2001-2018
Number of patients per 100,000
Year
D43, men
D43, women
D43, all

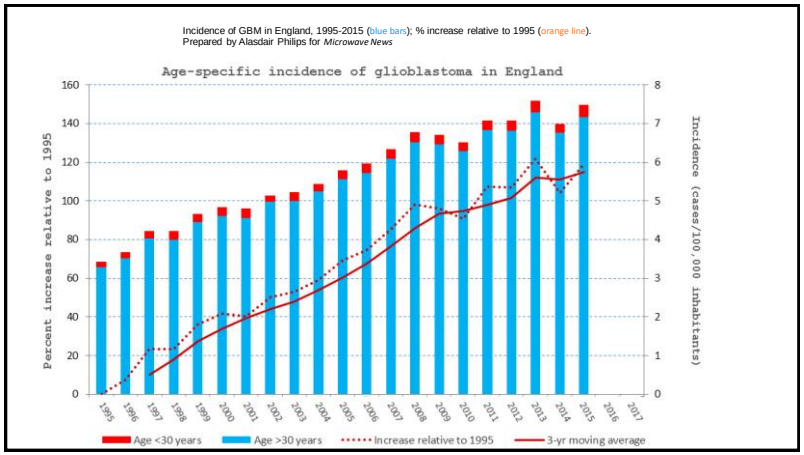
22


Röösli M, Lagorio S, Schoemaker MJ, Schüz J, Feychting M. Brain and Salivary Gland Tumors and Mobile Phone Use: Evaluating the Evidence from Various Epidemiological Study Designs. Annu Rev Public Health. 2019 Jan 11. doi: 10.1146/annurev-publhealth-040218-044037

23


Incidence of GBM in Denmark, 1995-2017 (blue bars); % increase relative to 1995 (orange line).
Prepared by a Danish epidemiologist for Microwave News.
Incidence of glioblastoma in Denmark
Percent increase relative to 1995
Incidence (cases/100,000 inhabitants)
Less than 5 cases
Age<30 yrs.
Age>30 yrs.
Increase relative to 1995
3-yr moving average

24



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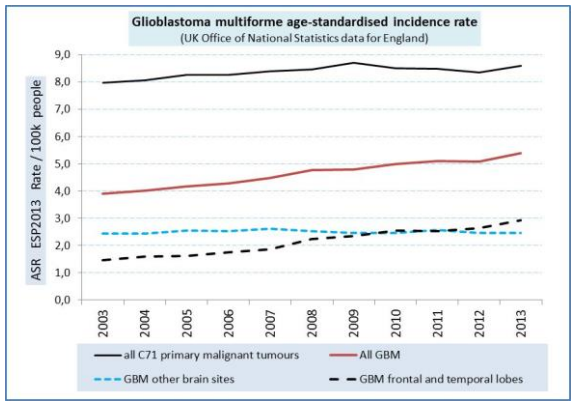


26

Headache, tinnitus and hearing loss in the international Cohort Study of Mobile Phone Use and Health (COSMOS) in Sweden and Finland

Anssi Auvinen ,1,2* Maria Feychting,3 Anders Ahlbom,3 Lena Hillert,3,4 Paul Elliott,5,6,7,8 Joachim Schu¨ z,9 Hans Kromhout ,10 Mireille B Toledano,5,6,7,8 Christoffer Johansen,11,12 Aslak Harbo Poulsen,11 Roel Vermeulen ,10 Sirpa Heina¨ vaara,1 Katja Kojo,1 Giorgio Tettamanti3 and the COSMOS Study Group†

Response rate 20.4 % in Sweden, 7.4 % in Finland

Excluded persons with headache, tinnitus, hearing loss at base line

Weekly headache OR 1.21, 95 % CI 1.02-1.43
After that multiple adjustments including pain killers – no statistically significant increased risk

27

Are there any health risks?

London September 2019

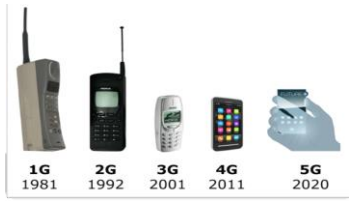
28

Radiofrequency radiation

• 90 MHz	Radio	• 2000 MHz	3G
• 300 MHz	TV	• 2600 MHz	4G
• **700 MHz**	**5G**	• 2450 + 5200 MHz	Wifi
• 800 MHz	4G	• **3400-3600 MHz**	**5G**
• 900 MHz	2G, 3G	• **26500-27500 MHz (26,5-27,5 GHz)**	**5G**
• 1800 MHz	2G		
• 1900 MHZ	DECT Cordless phone		

29

29



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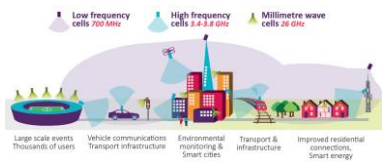
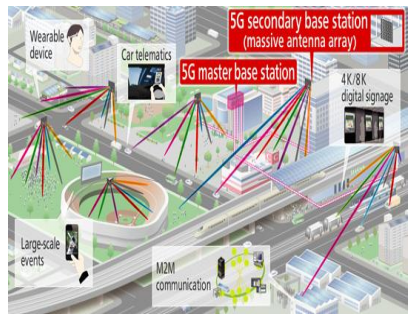


31



Two-way communication

Always trying to get best connection. Higher radiation level when buildnings, trees, vegetation, now, rain, fog etc. are involved

May need indoor antenna

32

IN-DEPTH ANALYSIS Requested by the ITRE committee (industrifrågor, forskning och energy)

5G Deployment, EU

State of Play in Europe, USA and Asia

Policy Department for Economic, Scientific and Quality of Life Policies
Directorate-General for Internal Policies
Authors: Colin BLACKMAN and Simon FORGE
PE 631.060 – April 2019

Three times more expensive than current system

Driven by Telecom

Convince governments that 5G is needed

Industry influence on governments that 5G is needed

33

34

The notion of a "race" is part of the campaign but it is becoming clear that the technology will take much longer than earlier generations to perfect.

China, for instance, sees 5G as at least a ten-year program to become fully working and completely rolled out nationally.

35

The technologies involved with 5G are much more complex.

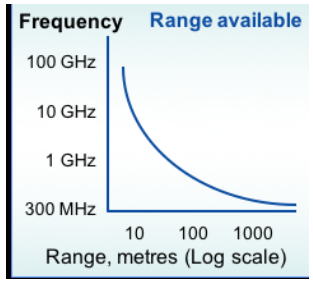
One aspect, for example, that is not well understood today is the unpredictable propagation patterns that could result in unacceptable levels of human exposure to electromagnetic radiation.

36

Focused beams: Rather than transmitting a wide area broadcast spread over a segment of the cell around a base station, an "active antenna" technique is used to form a set of steerable radio beams with power focused on a small area – the receiving handset

37

Range reduced by square of distance



Problems
-rain
-snow
-fog
-trees, vegetation (especially during rain)
-buildings, walls, etc

38

Typical range 20 – 150 meter at higher frequencies

One square kilometer needs about 800 base stations if only 20 m range

All need battery backup

39

Small cell standards are needed to give the EU a way forward for high quality outdoor and indoor cellular connectivity to support a light-touch regulatory regime, essential to ensure rapid rollout of perhaps hundreds of small cells per square kilometer

40

5G Electromagnetic Radiation and Safety

Significant concern is emerging over the possible impact on health and safety arising from potentially much higher exposure to radiofrequency electromagnetic radiation arising from 5G.

Increased exposure may result not only from the use of much higher frequencies in 5G but also from the potential for the aggregation of different signals, their dynamic nature, and the complex interference effects that may result, especially in dense urban areas.

41

The 5G radio emission fields are quite different to those of previous generations because of their **complex beam formed transmissions in both directions** – from base station to handset and for the return.

Although fields are highly focused by beams, they vary rapidly with time and movement and so are **unpredictable**, as the signal levels and patterns interact as a closed loop system. This has yet to be mapped reliably for **real situations**, outside the laboratory

42

In line with EECC Article 57, the EU is crafting a regime for SAWAP deployment, aiming for permit-free installation from 2020.

The level of marketing activity is key, with intense lobbying of governments by equipment suppliers and operators – and also of the public by governments.

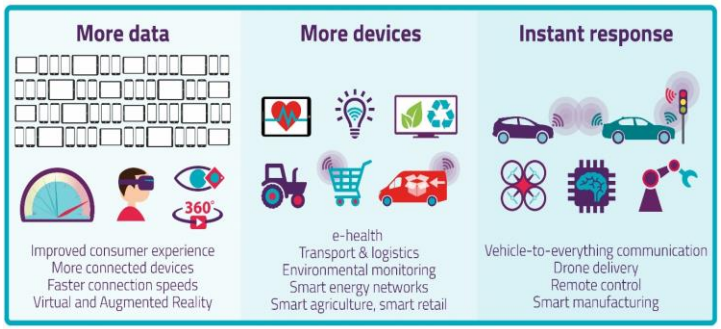
43

Recommendation 1:
Increasing R&D efforts on the technology of 5G

Long-term technology research is essential. One key problem is the unusual propagation phenomena, especially controlling and measuring RF EMF exposure with MIMO at mmWave frequencies for the handset and the base station.

The technology presents challenges to the current level of expertise (based on previous generations of mobile cellular radio engineering) both for suppliers and standards organizations who must incorporate the specifications in future 5G standards

44



45

Beamforming – several antenna in the same direction

*"However, since the radiation is concentrated into selected portions of territory, there **may be an increase of EMFs in these points**".*

Chiaraviglio, L., Cacciapuoti, A. S., Martino, G. D., Fiore, M., Montesano, M., Trucchi, D., & Melazzi, N. B. (2018). Planning 5G Networks Under EMF Constraints: State of the Art and Vision. *IEEE Access*, *6*, 51021–51037. https://doi.org/10.1109/ACCESS.2018.2868347

46

5G

- Skin
- Eyes
- Sweat glands – antenna effect
- Effects on bacteria
- Antibiotica resistance

Le Drain 2017, Russell 2018, Feldman 2008, Betzalel 2018, Soghomoyan 2016.

47

Hence, for a given total output power, SAR may be lowered by "spreading "the power over a larger mass, or equivalently, larger tissue volume. The picture in Figure 1 exemplifies the idea: a given amount of light power captured in a lens can be converted from a harmless state to a harmful one by increasing its density

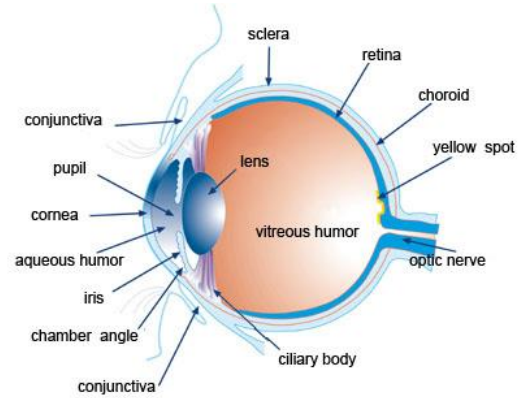
48

Permanent tissue damage

The results also show that the peak-to-average ratio of 1,000 tolerated by the International Council on Non-Ionizing Radiation Protection guidelines may lead to permanent tissue damage after even short exposures, highlighting the importance of revisiting existing exposure guidelines.

Neufeld, Kuster, Health Phys. 115(6):705–711; 2018

49



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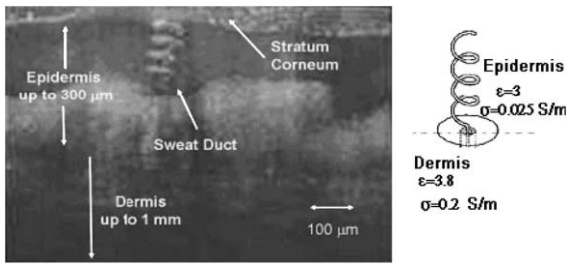
Sweat glands in the skin may act as antennas for the 5G signal

Feldman et al 2008



51

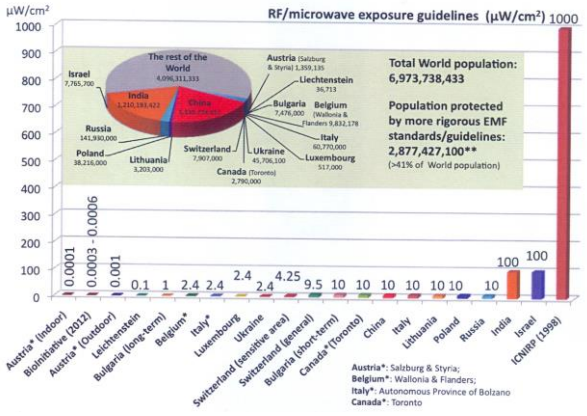
International Commission on Non-Ionizing Radiation

ICNIRP

10 W/m^2 = 61 V/m

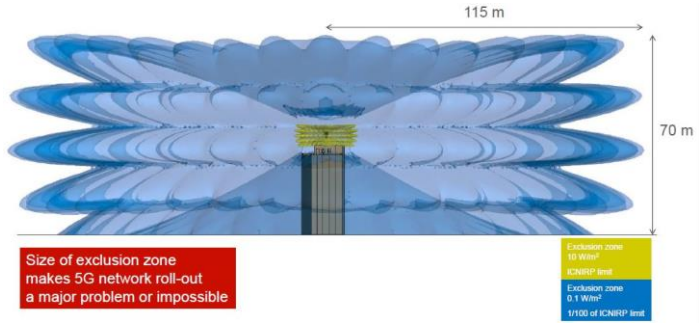
Hardell L: World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review). Int J Oncol 51: 405-413, 2017.

52



53

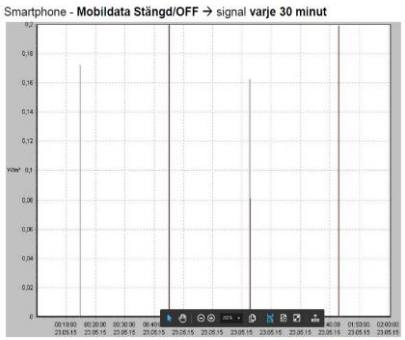
Exclusion zone makes 5G impossible in countries with lower guidelines; 0.1 W/m² gives 115 m exclusion zone!



Källa: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/S3_Christer_Tornevik.pdf

54

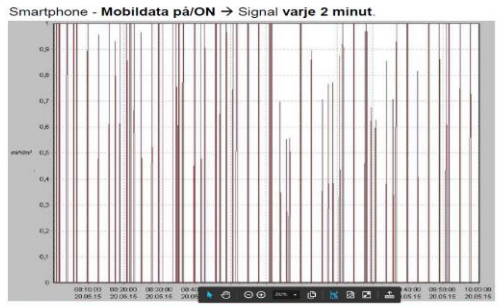
Without mobile data a signal every 30th minute – stand by signal to the base station



Mätningar: Ingenjör, doktor Dietrich Moldan, http://www.drmoldan.de

55

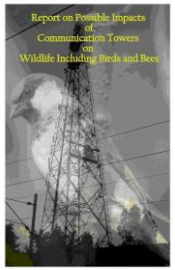
With mobile data + apps: Strong RFR-spikes especially for 4G data, almost every second! With Whats/App, Facebook etc a signal almost every second



OBS! OM apps på (WhatsApp, Facebook osv), då signal nästan varje sekund!

56

Effects on bees, birds and plants by radiofrequency radiation



Three reviews show damage:

Cucurachi *et al.* (2013).
http://www.ncbi.nlm.nlm.nih.gov/pubmed/23261519

Balmori (2009):
http://www.ncbi.nlm.nlm.nih.gov/pubmed/19264463

Sivani & Sudarsanam (2012).
http://www.biolmedonline.com/Articles/Vol4_4_2012/Vol4_4_202-216_BM-8.pdf

+ http://www.indiaenvironmentportal.org.in/files/file/final_mobile_towers_report.pdf

http://www.ncbi.nlm.nih.gov/pubmed/23915130

57

WHO Radio Frequency fields: Environmental Health Criteria Monograph

A 'formal risk assessment' was initiated by WHO in **2012.** A draft was published in **2014.**
Of the 6 members 4 are active in ICNIRP and 1 is a previous member.
The final document is still to be published

Table 1. Members of WHO Monograph core group and their involvement in different other groups.

Name	WHO	ICNIRP	UK/AGNIR	SSM	SCENIHR
Simon Mann	X	X	X		
Maria Feychting	X	X	X	X*	
Gunnhild Oftedal	X	X			
Eric van Rongen	X	X		X	
Maria Rosaria Scarfi	X	X*		X	X
Denis Zmirou	X				

**former*
WHO: World Health Organization
ICNIRP: International Commission on Non-Ionizing Radiation Protection
AGNIR: Advisory Group on Non-Ionising Radiation
SSM: Strålsäkerhetsmyndigheten (Swedish Radiation Safety Authority)
SCENIHR: Scientific Committee on Emerging and Newly Identified Health Risks

58

59