

# Cell Phones, Cell Towers, and Wireless Safety

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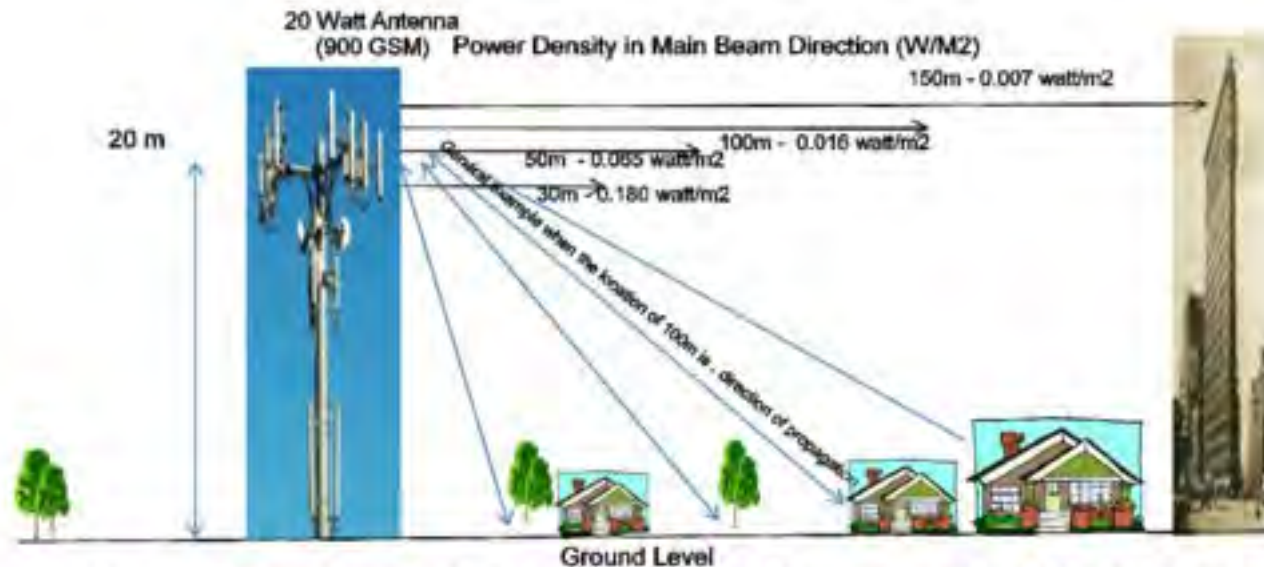
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Center for Family and Community Health  
School of Public Health, UC Berkeley

“Balancing Technology”  
University Health Services, UC Berkeley

February 27, 2019

[Saferemr.com](http://Saferemr.com)

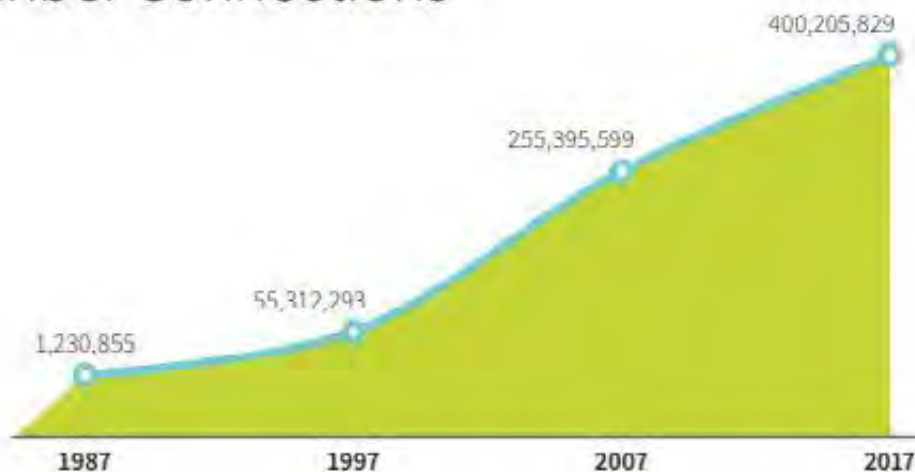
# Cell Phone Basics





# Rapid growth in cell phone use

Estimated Wireless  
Subscriber Connections



Estimated Connections Equal **120.7%** of U.S. Population

ctia

**400 million**  
**“subscriber**  
**connections”**

**\$179 billion**  
**annual revenue**

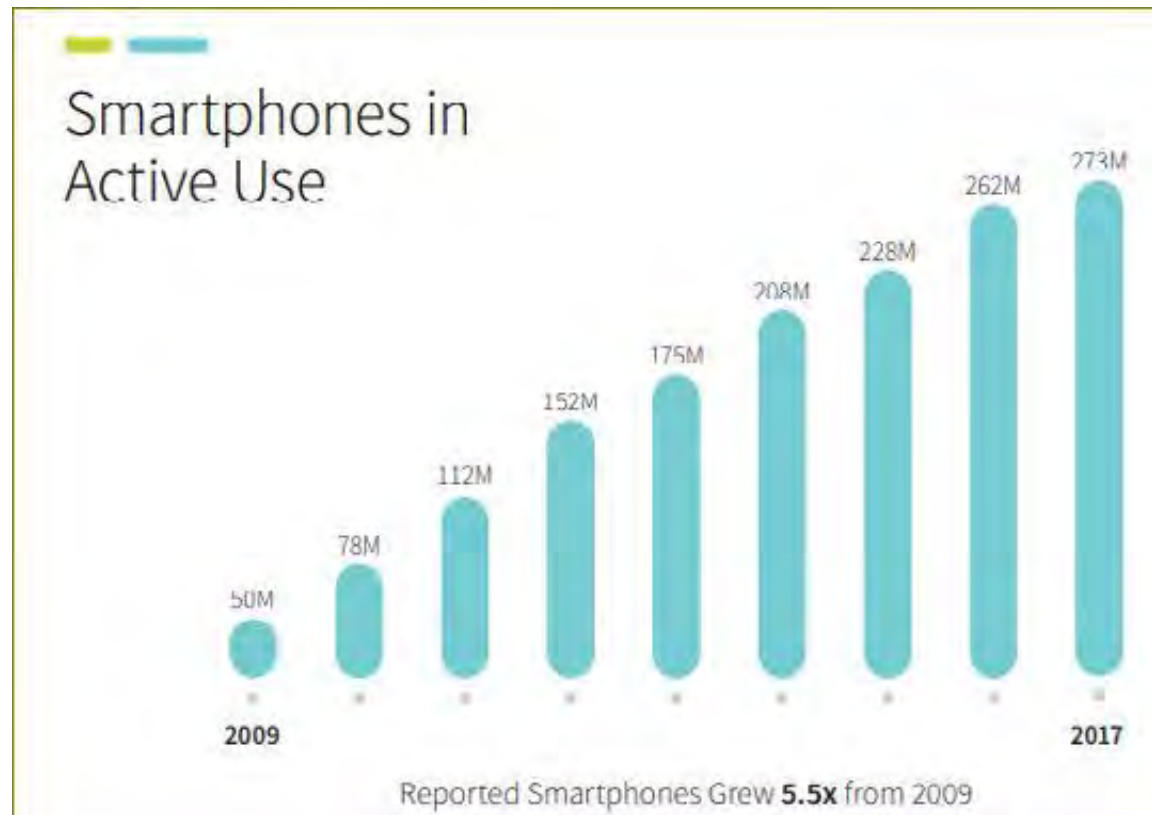
**88 hours/year**  
**avg. voice use**

**CTIA: Dec. 2017**

<http://bit.ly/ctia2017>



# Rapid growth in smartphone use





# Device use is prevalent among teens

## Device ownership among U.S. teens, by demographic group

*% of U.S. teens who say they have or have access at home to a ...*

	Smartphone	Cellphone that is not a smartphone	Desktop or laptop computer	Gaming console
U.S. teens	95	29	88	84

Source: Survey conducted March 7-April 10, 2018.  
"Teens, Social Media & Technology 2018"

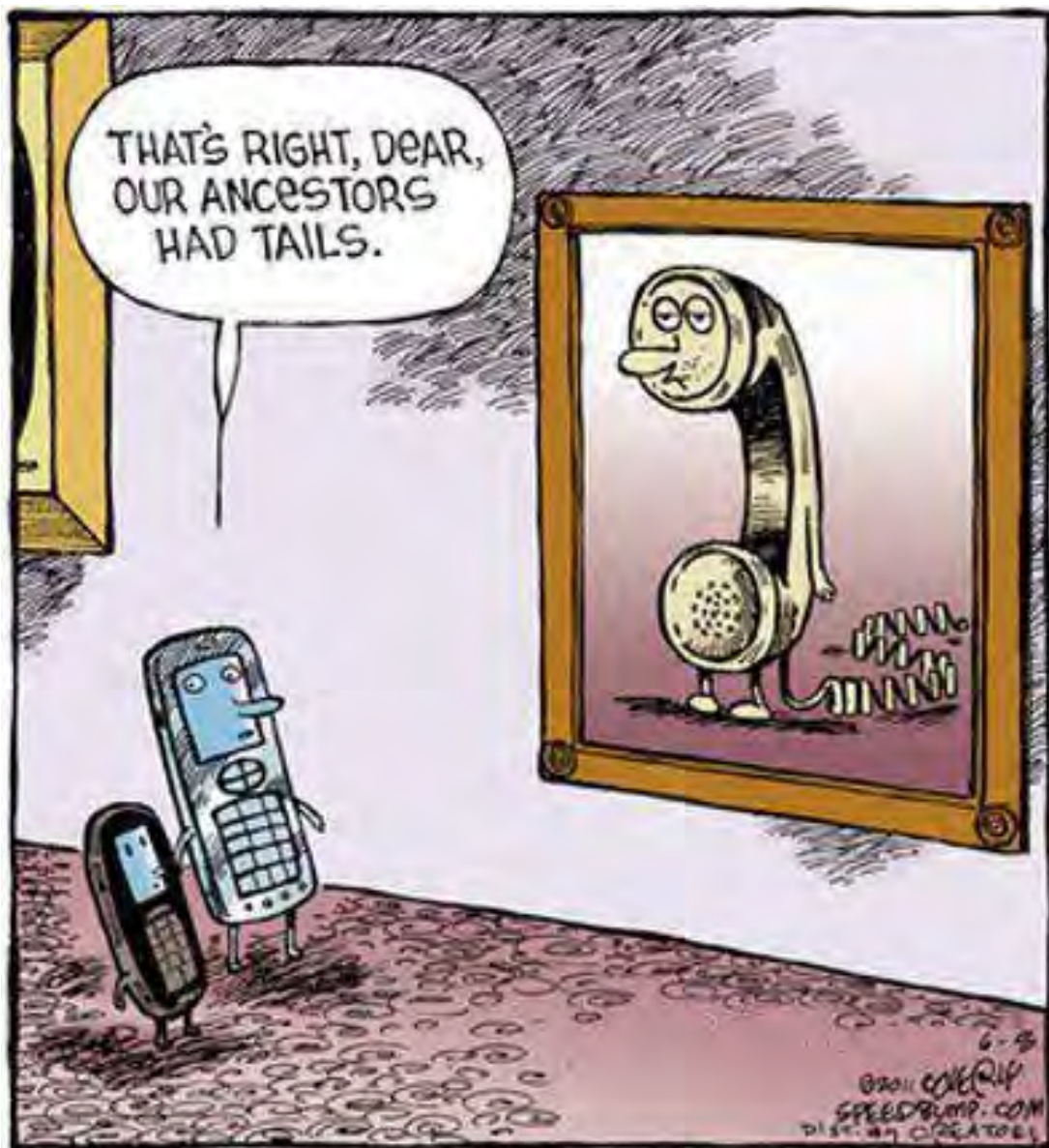
PEW RESEARCH CENTER

<http://bit.ly/Pewsurvey2018>





# Demise of the landline telephone



## US Households (Jan-Jun, 2018)

- 54.9% wireless-only
- 36.3% mixed-use
- 5.4% landline-only
- 3.3% no phone

NHIS. NCHS, CDC. Dec., 2018.  
<http://bit.ly/NCHS1218>



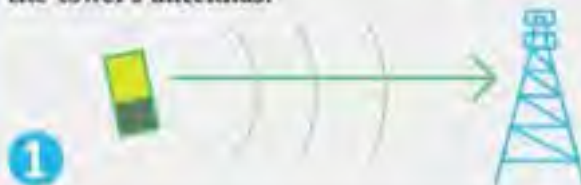
# How do cell phones work?

## How A Cell Phone Call Works

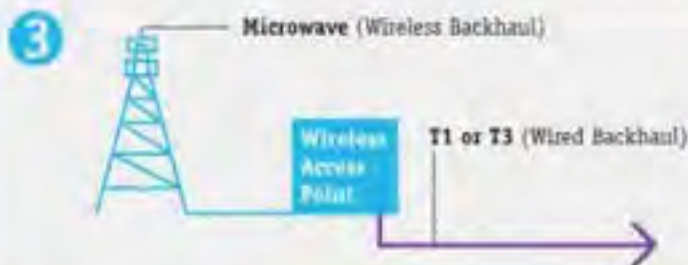
### The Basics

Cell phones are radio devices — they communicate by transmitting and receiving voice over an area.

First a cell phone radios the nearest cell tower (or *site*). When you make a call or turn your phone on, your phone sends a message via radio that's picked up by the tower's antennas.



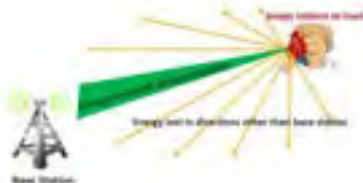
Next, a wire or fiberoptic line carries the call down to the wireless access point, connected to a multi-port switch.



The call (along with many others) gets routed to a backhaul — usually down to an underground wired T1 or T3 line, but sometimes back up the mast to a powerful line-of-sight wireless microwave antenna (typically only used either when there isn't a ground connection, or when the ground connection is poor).



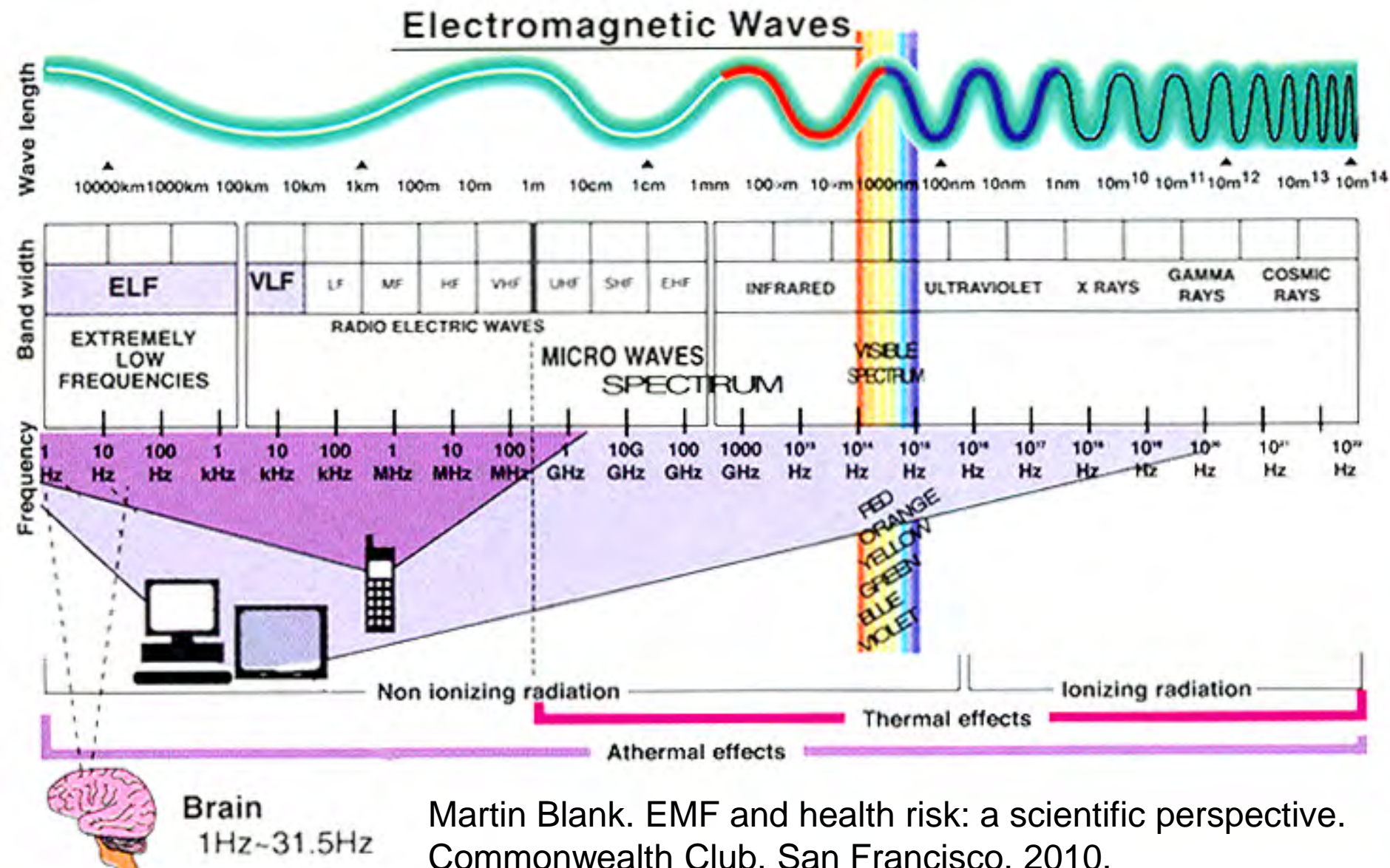
The incoming call or data comes back from the backhaul and up through the switch to the antenna, where it then hits your phone (presuming your phone is still communicating with the same site). If you are moving, then there's a handoff—a new but more or less identical cell site transmits the data to your phone, once your phone checks in.







# Electromagnetic spectrum

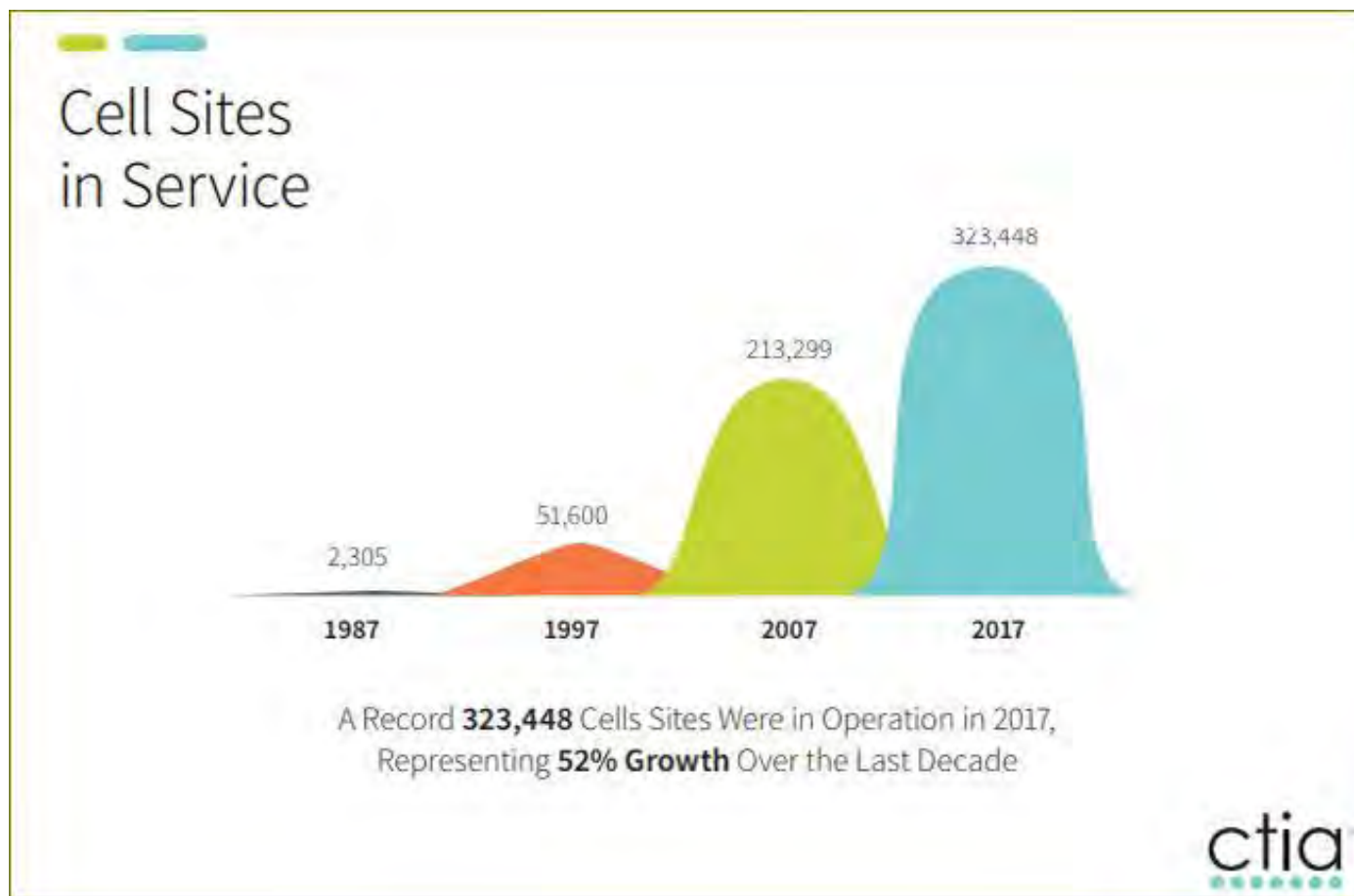


Martin Blank. EMF and health risk: a scientific perspective. Commonwealth Club. San Francisco. 2010.





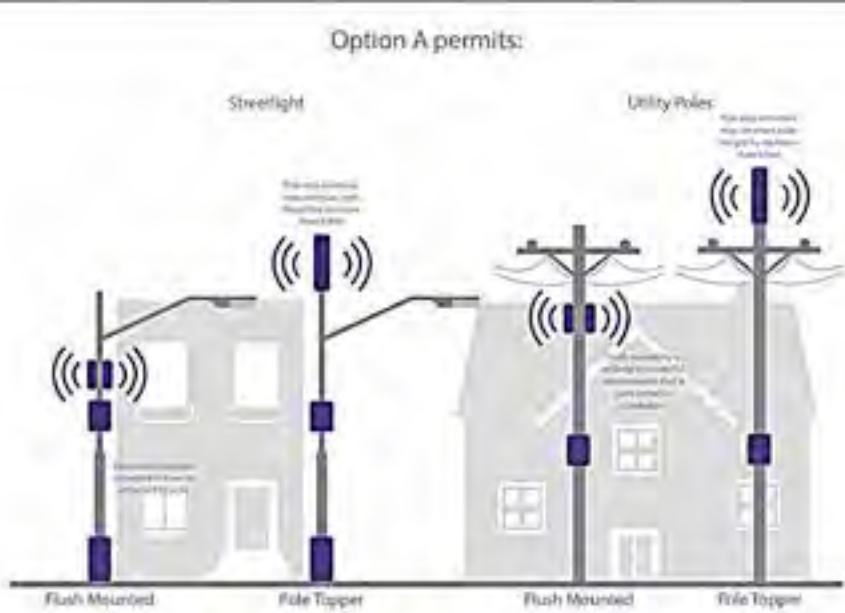
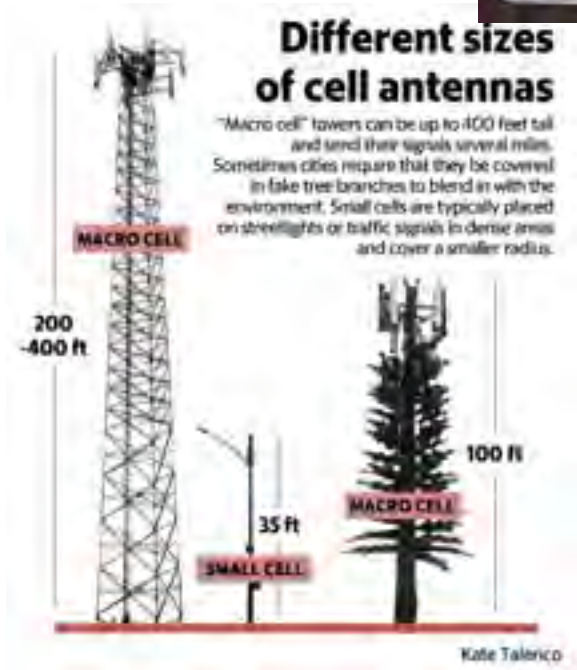
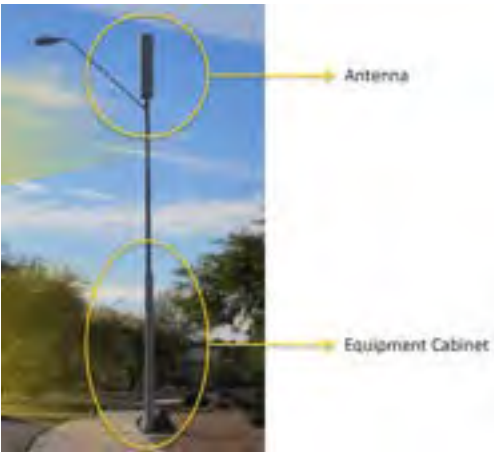
# Rapid growth in cell antenna sites



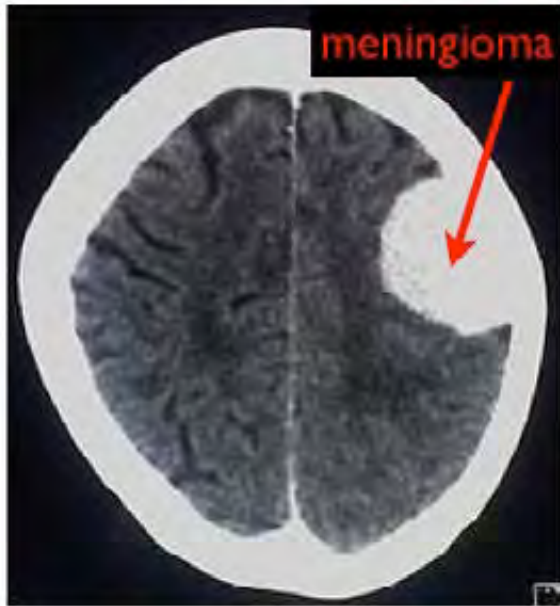
Cell Tower Health Effects



# Cell antennas vary greatly



# Research



# IARC expert working group



International Agency for Research on Cancer



World Health  
Organization

## PRESS RELEASE N° 208

31 May 2011

### IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, associated with wireless phone use.





# Glioma risk: Case-control studies

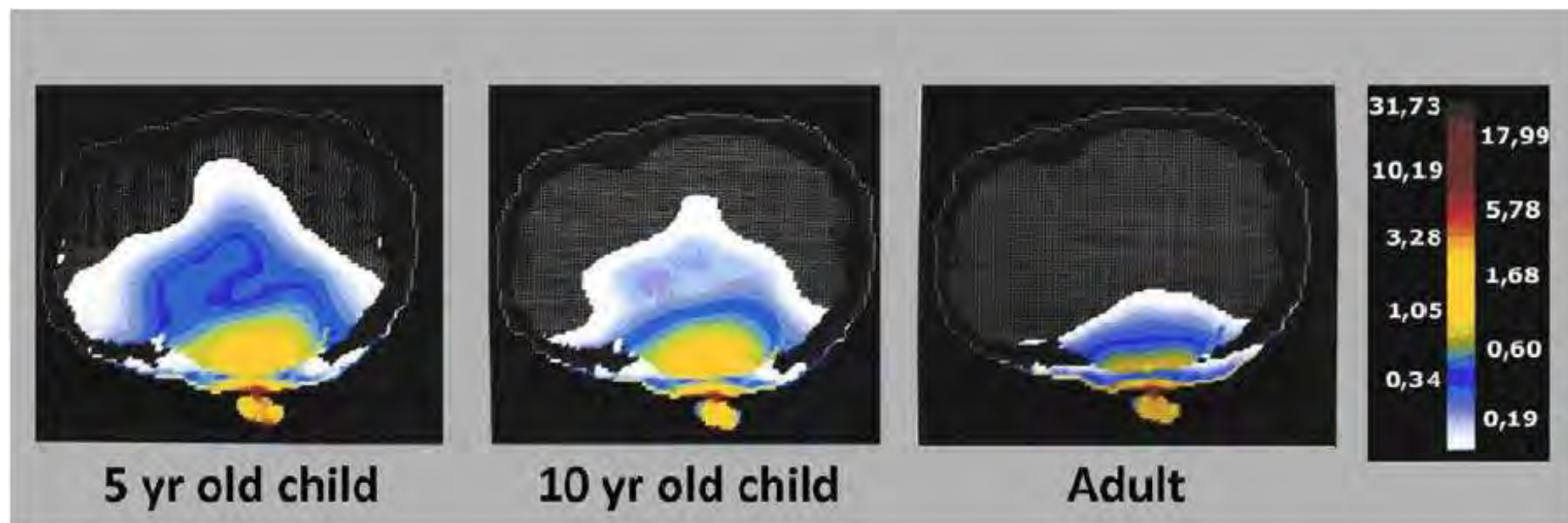
	<b>Interphone (2010)</b>	<b>Interphone (App. 2) (2010)</b>	<b>Hardell (2013)</b>	<b>CERENAT (2014)</b>
<b>“Heavy” Lifetime Use</b>	<b>1.40*</b> <b>1640+ hrs</b>	<b>1.82*</b> <b>1640+ hrs</b>	<b>1.75*</b> <b>1640+ hrs</b>	<b>2.89*</b> <b>896+ hrs</b>
<b>10+ years</b>	<b>0.98</b>	<b>2.18*</b>	<b>1.79*</b>	<b>1.61</b>

**Estimated lifetime risk of glioma in US is from 1 in 200 to 1 in 250.**

**78,000 malignant & non-malignant brain tumors per year in U.S.**



# Child's brain absorbs 2X the radiation



**Figure 1.** Estimation of the penetration of electromagnetic radiation from a cell phone based on age (Frequency GSM 900 Mhz) (On the right, a scale showing the *Specific Absorption Rate* at different depths, in W/kg) [1]\*

Gandhi et al., 2012



# Children's brain tumor risk

- CEFALO
  - 998 7-19 year olds from Denmark, Sweden, Switzerland, Norway
  - Overall 36% ↑ risk for “**regular**” cellphone use (ns)
  - Subgroup w/ cell phone company records: 2.8+ years of cellphone use → 214% ↑ risk (signif.)
- MOBI-Kids
  - 1,810 10-24 year olds from 14 nations
  - Data collected: 2009-2014
  - Final results: 2019?

# National Toxicology Program Study: Final Reports (2018)



National Toxicology Program

Headquartered at the  
National Institute of Environmental  
Health Sciences NIH-HHS

## Cell Phone Radio Frequency Radiation Studies

### What did the studies find?

NTP studies found that exposure to high levels of RFR, like that used in 2G and 3G cell phones, was associated with:

- **Clear evidence of tumors in the hearts of male rats.** The tumors were malignant schwannomas.
- **Some evidence of tumors in the brains of male rats.** The tumors were malignant gliomas.
- **Some evidence of tumors in the adrenal glands of male rats.** The tumors were pheochromocytomas.

For female rats, and male and female mice, it was unclear, also known as equivocal, whether cancers observed in the studies were associated with exposure to RFR.

### *Do the rat and mouse findings apply to humans?*

*The findings in animals cannot be directly applied to humans for two key reasons:*

- *The exposure levels and durations were greater than what people may receive from cell phones.*
- *The rats and mice received RFR across their whole bodies, which is different from the more localized exposures humans may receive, like from a cell phone in their pocket or next to their head.*

*However, the studies question the long-held assumption that radio frequency radiation is of no concern as long as the energy level is low and does not significantly heat the tissues.*



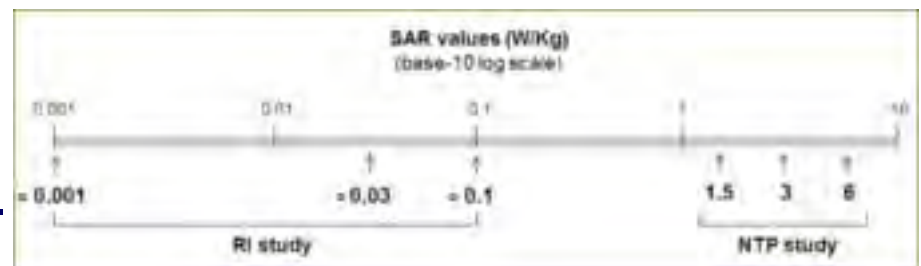


# NTP Study: Other effects

- DNA damage in brains of male & female mice & rats.
- Increased degeneration in hearts of male & female rats.
- Decreased birth weights in rats exposed prenatally.
- Overall tumor incidence in male rats was greater after 2 years of cell phone radiation exposure (in **Appendix**).
  - Highest overall cancer incidence (42%-46%) in middle exposure groups (3 watts per kilogram [W/kg]); significantly greater than sham control group (27%).
  - Lowest exposure groups (1.5 W/kg) had significantly greater non-malignant tumor incidence (73%-76%) vs. sham control group (54%).

- [Ramazzini Institute study](#)

Replicates the key NTP results.



# Health risks in humans from cell phone use



- **Tumors:** glioma (glial cells), acoustic neuroma (Schwann cells), meningioma, parotid, pituitary & thyroid glands; breast
- **Reproductive harm:** sperm damage, male infertility, miscarriage, preterm birth
- **Prenatal/children:** headaches, hearing problems, impaired memory, ADHD, autism?
- **Electrohypersensitivity:** fatigue, headaches, insomnia, tinnitus, heart palpitations, etc.

# Electrohypersensitivity vs. demyelination symptoms



**TABLE 1.** Symptoms Reported by People After Exposure (or Presumed Exposure) to RF-EMFs With Symptoms of Demyelination

	Symptoms of electrohypersensitivity	Symptoms of demyelination
Vision	Difficulty in seeing, smarting, pain	Blurred vision Progressive vision loss/blurring (children), pain, light flashes (children)
Motor	Trunk/limb/joints aches, pain Numbness Weakness	Trunk/limb weakness Numbness Weakness and fatigue Balance problems
Sensory	Tickling, prickling, burning sensations (ie numbness, paraesthesia)	Numbness, paresthesia (i.e., tickling, prickling, burning sensations)
Cerebellar	Tremor Faintness Dizziness Sleep problems Headaches Abnormally tired/sleep problems	Tremor Ataxia (reduced muscle control, incoordination) Seizures (children) Balance problems (children) Lethargy (children)
Cognitive/neuropsychiatric/ emotional	Short and long term memory impairment Lack of concentration Difficulty learning new things Irritability Anxiety Stress (feeling of lack of control) Mood changes (including anger) Depression	Memory impairment Concentration impairment Irritability Anxiety Confusion (children)

Note: Sources: ESUK (2014); Mar (2014); National Multiple Sclerosis Society (2014).

To cite this article: Mary Redmayne & Olle Johansson (2014) Could Myelin Damage From Radiofrequency Electromagnetic Field Exposure Help Explain the Functional Impairment: Electrohypersensitivity? A Review of the Evidence, *Journal of Toxicology and Environmental Health, Part B*, 17:5, 247-258, DOI: 10.1080/10937404.2014.923356

To link to this article: <https://doi.org/10.1080/10937404.2014.923356>



# Cell tower epidemiologic studies

TABLE 1. Summary of Epidemiological Studies of Mobile Phone Base Station Health Effects

Publication (Year; Country)	Clinical Assessment	Study Design	Base Station Details	Participants	EMF Measured	Key Findings	Strengths	Limitations
Niwaori <sup>a</sup> (2003; Spain)	Neuro-behavioral	Survey-questionnaire	GSM DCS 1800 MHz	101	Yes	More symptoms with closer proximity to base station (< 150 m)	Detailed questionnaire, EMF measured, distances studied <sup>b</sup>	Low participation, self-estimated distances, subjects unaware <sup>c</sup>
Santini <sup>a</sup> (2003; France)	Neuro-behavioral	Survey-questionnaire	n/s	530	No	More symptoms with closer proximity to base station (< 300 m)	Detailed questionnaire, distances & other EMF exposures assessed	As above, plus no EMF measurements, no base station details
Eger <sup>a</sup> (2004; Germany)	Cancer incidence	Retrospective case review	GSM 905 MHz	967	No	3 x risk of cancer after 5 yrs of exposure (< 400 m), early age of cancer diagnosis	Maximum beam intensity calculated, reliable cancer data collection	Other environmental risk factors not assessed, analysis not adjusted for age and sex
Witt & Witt <sup>a</sup> (2004; Israel)	Cancer incidence	Retrospective case review	TDMA 850 MHz	1644	Yes	~4 x risk of cancer after 6-7 yrs exposure (< 150 m), early age of cancer diagnosis	Reliable cancer & demographic data, no other major environmental pollutants identified	Not all environmental risk factors assessed; possible selection bias; no age, sex adjustment
Godzycki <sup>a</sup> (2006; Poland)	Neuro-behavioral	Survey-questionnaire	n/s	500	No	More headaches with proximity < 150 m; nocicebo unlikely <sup>c</sup>	Detailed questionnaire, distances & EMF studied, nocicebo studied	Subjects diverse, no base station details
Harter <sup>a</sup> (2006; Austria)	Neuro-behavioral	Cross-sectional	900 MHz	336	Yes	Headaches & impaired concentration at higher power density; nocicebo unlikely	Detailed questionnaire and testing, EMF measured, distances studied; nocicebo effect studied	Subjects aware, low participation rate
Meyer <sup>a</sup> (2006; Germany)	Cancer incidence	Retrospective case review	n/s	117/626	No	No increased cancer incidence in municipalities with or without base stations	Wide population assessed (flavonol)	Observation period only 9 years, vague definition of exposure, exposure onset unknown, distance to base station unknown
Abdel-Gawad <sup>a</sup> (2007; Egypt)	Neuro-behavioral	Cross-sectional	n/s	185	Yes	More symptoms & lower cognitive performance if living under or < 10 m from base station	Detailed questionnaire and testing, EMF measured, distances studied, subjects unaware	Exact time station details n/s, low number of participants
Bethner <sup>a</sup> (2009; Germany)	Neuro-behavioral	Cross-sectional	n/s	300/17	No	More health complaints closer to base station (< 500 m)	Wide population assessed, detailed survey, nocicebo effect assessed	EMF measurements not carried out (see phase II in Berg-Heckhoff et al., 2009; below)
Berg-Heckhoff <sup>a</sup> (2009; Germany)	Neuro-behavioral	Cross-sectional	GSM 900 MHz GSM 1800 MHz UMTS 1920-1980 MHz	1326	Yes	Health effects probably caused by stress and not by RF-EMF	Measured EMF emissions, standardized questionnaires	Low participation, no detailed list of symptoms published, single "spot" measurement in one place in dwelling, no occupational exposure assessed, time log from assessment of symptoms and EMF measurement

n/s = not specified.

<sup>a</sup>"Distance" refers to distance between base station and subjects' households.

<sup>b</sup>"Subjects aware" refers to study participants being aware of the nature of the study.

<sup>c</sup>"Nocicebo" effect unlikely because the majority of subjects in the study reported little or no concern for base station proximity.





# International EMF Scientist Appeal

- Calls for stronger regulation of EMF (electromagnetic fields) & health warnings.
- Signed by 247 EMF scientists (2019).
  - Published >2,000 EMF papers; 42 nations.

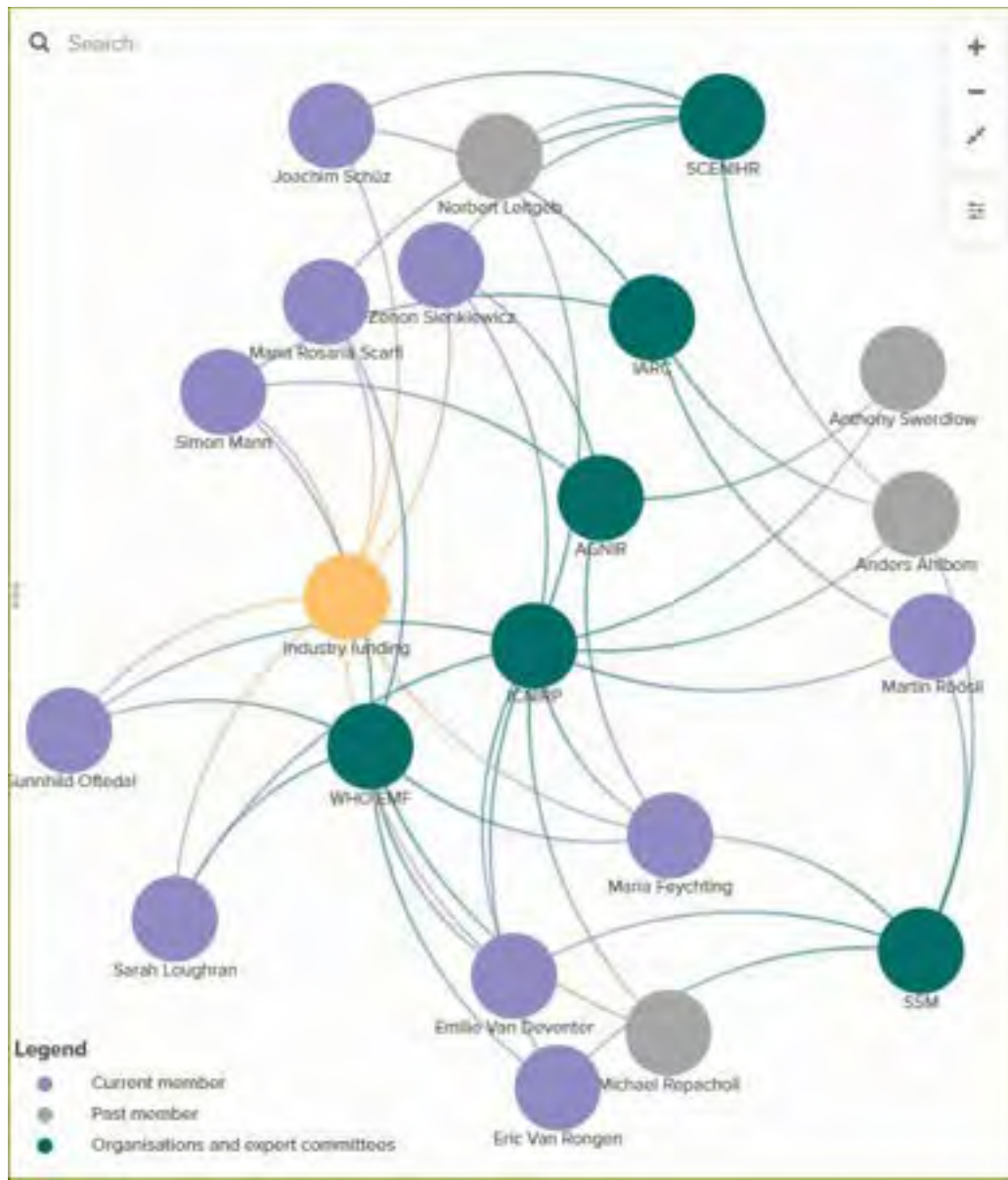
## **Scientific basis for our common concerns**

“Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.”



[EMFscientist.org](https://www.emfscientist.org)

# The ICNIRP “Cartel”



*"5G ... could also harm your health. Europe's governments ignore the danger."*

Investigate Europe, a team of journalists, identified 14 scientists who defend ICNIRP's obsolete exposure guidelines by preparing biased reviews of the scientific literature. At least eight have had industry research funding.

<http://bit.ly/ICNIRPcartel>

<http://bit.ly/5Gmassexperiment>

# Policy



## 1996 Telecommunications Act pre-empts consideration of health effects in placement of cell towers

Without completely preempting the authority of local governments to make decisions regarding the placement of wireless communications facilities,<sup>12</sup> the Act provides five separate and substantial protections for the telecommunications facility applicant in the amended 47 U.S.C. § 332 (entitled National Wireless Telecommunications Siting Policy).<sup>13</sup> Section 332 provides that:

(D) no state or local governmental entity may regulate the placement, construction, or modification of personal wireless service facilities on the basis of environmental effects of radio frequency emissions to the extent that such emissions comply with FCC regulations; and



# U.S. government: “Wait and see”

- **Wait and see:** demands conclusive evidence
  - Federal govt. made minimal investment in research
    - 1999: [FDA called for NTP cell phone radiation study](#)
    - 2018: [NTP final reports released](#)
  - [Cities of Boston & Philadelphia \(2013\)](#): “overlap of federal agency responsibilities ... leaves leadership unclear and encourages a **pass-the-buck attitude**.”
  - [U.S. Dept of Interior \(2014\)](#): “electromagnetic radiation standards used by the FCC continue to be based on thermal heating, a criterion now nearly **30 years out of date** and inapplicable today.”
  - [Senator Richard Blumenthal \(2019\) re: 5G](#)

At the end of the exchange, Blumenthal concluded, “So there really is no research ongoing. We’re kind of flying blind here, as far as health and safety is concerned.”



# US: Dysfunctional Radio Frequency Interagency Work Group



*Alster N. Captured agency: How the FCC is dominated by the industries it presumably regulates.* <http://bit.ly/FCCcaptured>



# Agencies & organizations call for changes in FCC's RF limits or testing



# US federal & WHO websites:

## Misleading risk minimization language



- NCI: “currently **no consistent evidence** that non-ionizing radiation increases cancer risk ...The only consistently recognized biological effect of radiofrequency energy is heating.”
- FDA: “The **scientific evidence does not show a danger to any users** of cell phones from RF exposure, including children and teenagers.”
- FCC: “currently **no scientific evidence establishes a causal link** between wireless device use and cancer or other illnesses.”
- WHO: “To date, **no adverse health effects have been established as being caused by** mobile phone use.”

# Industry influence: CTIA—The Wireless Association



*“The FCC, the FDA, the WHO, the American Cancer Society and numerous other international and U.S. organizations and health experts say that the scientific evidence shows no known health risk due to the RF energy emitted by cellphones.”*

CTIA, Feb 9, 2018

<http://bit.ly/CTIAstates>





# Industry influence:

## *Microwave News & The Nation*



<http://Microwavenews.com>



<http://bit.ly/BigWireless>

# San Francisco: Cell phone “right to know” ordinance



- 2010: SF Board of Supervisors adopted law
- 2010: CTIA filed federal lawsuit
- 2011: Supervisors revised fact sheet based on judge's ruling
- 2012: 9<sup>th</sup> Circuit Appeals Court overturned lower court in unpublished opinion
- 2013: Supervisors killed law

<http://bit.ly/sflaw>



# City of Berkeley: Cell phone “right to know” ordinance



- 2015: City Council adopted law
- 2015: CTIA filed federal lawsuit
- 2015: City adopted minor revision based on court ruling
- 2016: Law took effect
- 2017: 9<sup>th</sup> Circuit Appeals Court upheld federal District Court
- 2018: CTIA appealed to U.S. Supreme Court; case returned to 9<sup>th</sup> Circuit

<http://bit.ly/berkeleycell>



# City of Berkeley: Cell phone notice



**The City of Berkeley requires that you be provided the following notice:**

To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. Refer to the instructions in your phone or user manual for information about how to use your phone safely.





# California Department of Public Health



- 2009: CDPH drafted cell phone safety guidance but suppressed it
- 2014: Three public records requests
- 2016: Lawsuit by UC Berkeley Environ. Law clinic & First Amendment Project
- 2017: Court ordered release of draft guidance documents
- 2017: CDPH published final guidance

<http://bit.ly/CDPHstory>

# CDPH: Cell phone safety guidance – Dec. 2017



Division of Environmental and Occupational Hazards | Division of California Department of Public Health

## How to Reduce Exposure to Radiofrequency Energy from Cell Phones



The use of cell phones has increased dramatically in recent years, including among children and young adults. These phones put out radio-frequency (RF) energy.

Some scientists and public health officials believe RF energy may affect human health. This guidance document describes RF energy, lists some of the potential health concerns, and provides guidance on how people can reduce their exposure.

### Why are people concerned about exposure to RF energy from cell phones?

Although the science is still evolving, some laboratory experiments and human health studies have suggested the possibility that long-term, high use of cell phones may be linked to certain types of cancer and other health effects, including:

- brain cancer and tumors of the acoustic nerve (involved in hearing and maintaining balance) and salivary glands
- lower testicular temperature in men who use cell phones
- headaches and effects on learning and memory, learning, behavior, and sleep

These studies do not establish the link definitively, however, and scientists disagree about whether cell phones cause these health problems and how great the risk might be. This document is intended to provide guidance for those people who want to reduce their own and their families' exposure to RF energy from cell phones, despite this uncertainty.

### What is RF energy?

Cell phones work by sending and receiving signals to and from cell phone towers. These signals are a type of electromagnetic radiation called radiofrequency (RF) energy. Other sources of RF energy include cell phone towers, TV and radio transmitters, smart meters, and microwave ovens. When a phone sends signals to a tower, the RF energy goes from the phone's antenna out in all directions, including into the head and body of the person using the phone. Cell phones also emit RF energy when using Wi-Fi and/or Bluetooth, but at lower levels.

RF energy is not as powerful as an X-ray or other ionizing radiation, but it can cause some types of electromagnetic radiation, such as X-rays or UV light from the sun. Some scientists think that, however, suggests that there may be some health risks from exposure to RF energy.

## Next Step: Now every city and county can disseminate this document.

### How can you reduce your exposure?

Keep your phone away from your body, keeping your phone just a few feet away from you can make a big difference:

- When you talk on your cell phone, avoid holding it to your head—use the speakerphone or a headset instead. In-car use (Bluetooth) and text messages also reduce RF energy from the phone.
- Send text messages instead of talking on the phone.
- If you are streaming or if you are downloading or sending large files, try to keep the phone away from your head and body.
- Carry your cell phone in a backpack, bag, purse, or pocket, keep it in a locker. Do not use your phone's antenna to talk to a tower with a cell tower antenna if you do not have to use it (even when you are not using it). It does not emit RF energy when it's in airplane mode. (Scientists think it turns off cellular, Wi-Fi, and Bluetooth.)

Reduce or avoid using your cell phone when it is sending out high levels of RF energy. This happens mostly when:

- You are only one or two feet away from a cell phone. Cell phones put out more RF energy to connect with a tower when the signal is weak. If you are not near your phone when the signal is weak, try to follow the other guidance in this guide.
- You are in a fast-moving car, bus, or train. Your phone gets out more RF energy to maintain connections in areas designed with an RF antenna power density that is not high in the car or train.
- You are streaming audio or video, or downloading or sending large files. To better reduce or limit exposure to your phone, download files, then delete or delete them when you are not using them.

DON'T sleep with your phone in your bed or near your head. When the phone is off or in airplane mode, keep it at least a few feet away from your bed.

Take off the headset when you're not using it. Headsets reduce your exposure to RF energy when you're not using your phone.



### What about children?

Children's bodies absorb RF energy more easily than adults' bodies.

- If a child is using a cell phone, avoid holding it to their head.
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For more information, visit the CDPH website at [www.cdph.ca](http://www.cdph.ca) or call 1-800-553-4464. For more information, visit the CDPH website at [www.cdph.ca](http://www.cdph.ca) or call 1-800-553-4464.

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CDPH cell phone safety guidance

# 5G: Latest threat to population & environmental health



- Electromagnetic Radiation Safety
  - Scientists and doctors demand moratorium on 5G
  - Is 5G harmful to our health?
  - Millimeter wave health effects
  - Cutting through the hype
  - Newspaper editorials oppose "small cell" antenna bills
- Physicians for Safe Technology
- Environmental Health Trust



# 5G: Scientists & doctors call for moratorium on deployment



- Moratorium on roll-out of 5<sup>th</sup> generation cellular technology
- 2017: Submitted to European Commission
- Signed by >200 scientists & physicians
  - 38 nations

[www.5gappeal.eu](http://www.5gappeal.eu)



# 5G: International Society of Doctors for the Environment Appeal



“5G networks in European Countries: Appeal for a standstill in the respect of the precautionary principle.”  
Apr 2018.

[http://www.isde.org/5G\\_appeal.pdf](http://www.isde.org/5G_appeal.pdf)

Albania	National Association of Hygienists of Albania (NAHA)
Algeria	Association for the Protection of the Environment and Sustainable Development (APESD): Association des jeunes volontaires pour la protection et la sauvegarde de l'environnement (AJVPSL)
Argentina	Asociación Argentina de Médicos por el Medio Ambiente (AAMMA)
Australia	Doctors for the Environment (Australia) Inc. (DEA)
Austria	Ärztinnen und Ärzte für eine Gesunde Umwelt (ÄGU) - ISDE Austria
Bangladesh	Environment and Social Development Organization (ESDO)
Belgium	Belgische Artsen voor het Milieu - Médecins Belges pour l'Environnement
Belgium	HECTOR asbl - Health and Environment Care Technical Organisation
Brazil	Médicos pelo Ambiente (MEPA)
Canada	Canadian Association of Physicians for the Environment (CAPE)
Ecuador	Corporación para el Desarrollo de la Producción y el Medio Ambiente Laboral
France	L'Association pour la Recherche Thérapeutique Anti-Cancéreuse, ARTAC
Germany	Ökologischer Ärztebund (ÖÄB)
India	Orissa State Volunteers and Social Workers Association (OSVSWA)
Italy	Associazione Medici per l'Ambiente - ISDE Italia
Kenya	Association of Physicians and Medical Workers for Social Responsibility, PSR Kenya
Macedonia	Združenje na Doktori za životna sredina MADE
Malta	Saħħambjent
Pakistan	Sustainable Development Policy Institute (SDPI)
Pakistan	National Integrated Development Association (NIDA Pakistan)
Netherlands	Nederlandse Vereniging voor Medische Milieukunde (NVMH)
Serbia	Society of ecologists in health-care (SEHC)
Sweden	Läkare för Miljön (LFM)
Switzerland	Ärztinnen und Ärzte für Umweltschutz, Médecins en Faveur de l'Environnement, Medici per l'Ambiente (ÄMA)
Turkey	Cevre İçin Hekimler Derneği
Ukraine	Green Doctors - Ukrainian Association of Doctors for the Environment
UK	British Society for Ecological Medicine (BSEM)
USA	Physicians for Social Responsibility (PSR)
Uzbekistan	Center Perzent - The Karabulpak Centre for Reproductive Health and Environment



# Emerging wireless technologies

- 5G (5<sup>th</sup> generation cellular technology)
- Internet of Things (IoT)
  - Smart appliances, TVs, thermostats, etc.
- Smart cities
- Autonomous motor vehicles
- Wearable wireless devices
  - Watches, glasses, ear buds, medical implants, etc.



# “Re-Inventing Wires”

National Institute for Science, Law & Public Policy (NISLAPP) recommends:

## **“Re-Inventing Wires: The Future of Landlines and Networks”**

by Timothy Schoechle, PhD

*Learn 13 ways “fiber to the premises” - rather than 4G/5G wireless antennas - strengthens U.S. communications, national security and the economy.*

### **“Fiber to the Premises” improves:**

- |   |  |
|---|--|
| 1. Speed of Internet access             | 9. Personal privacy                                    |
| 2. Neutrality of Internet access        | 10. Public health                                      |
| 3. Quality of voice communication       | 11. The biological ecosystem                           |
| 4. Reliability                          | 12. Landline phone access when the power goes out, and |
| 5. Energy usage and efficiency          | 13. The integrity of the communications system as      |
| 6. Resiliency in extreme weather events | a whole, which has become hijacked by commercial       |
| 7. Value for the money to all users     | motivations and riddled with planned obsolescence and  |
| 8. Safety and cybersecurity             | unnecessary future costs for us all.                   |

*All of these factors are important to constituents and our future.*

*Advanced Copper and Optical Fiber are Far Superior to Wireless in Both Cost and Performance.*

Read “Re-Inventing Wires: The Future of Landlines and Networks”  
and the “10 Recommendations for Communities and Policymakers”:

<https://tinyurl.com/y89sfng8>



# My concluding thoughts

**We are guinea pigs in a massive technological experiment that threatens our health. Our government needs to determine what constitutes a safe level of long-term exposure to wireless radiation and strengthen the FCC's radio frequency exposure guidelines. In the meantime, the government should impose a moratorium on technologies that increase our exposure to wireless radiation, especially new forms of wireless radiation like 5G cellphone radiation.**

**[NTP Cell Phone Radiation Study: Final Reports](#)**



# References



**References for this presentation  
are available at:**

<http://www.saferemr.com/2016/08/key-cell-phone-radiation-research.html>

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**[Saferemr.com](http://Saferemr.com)**

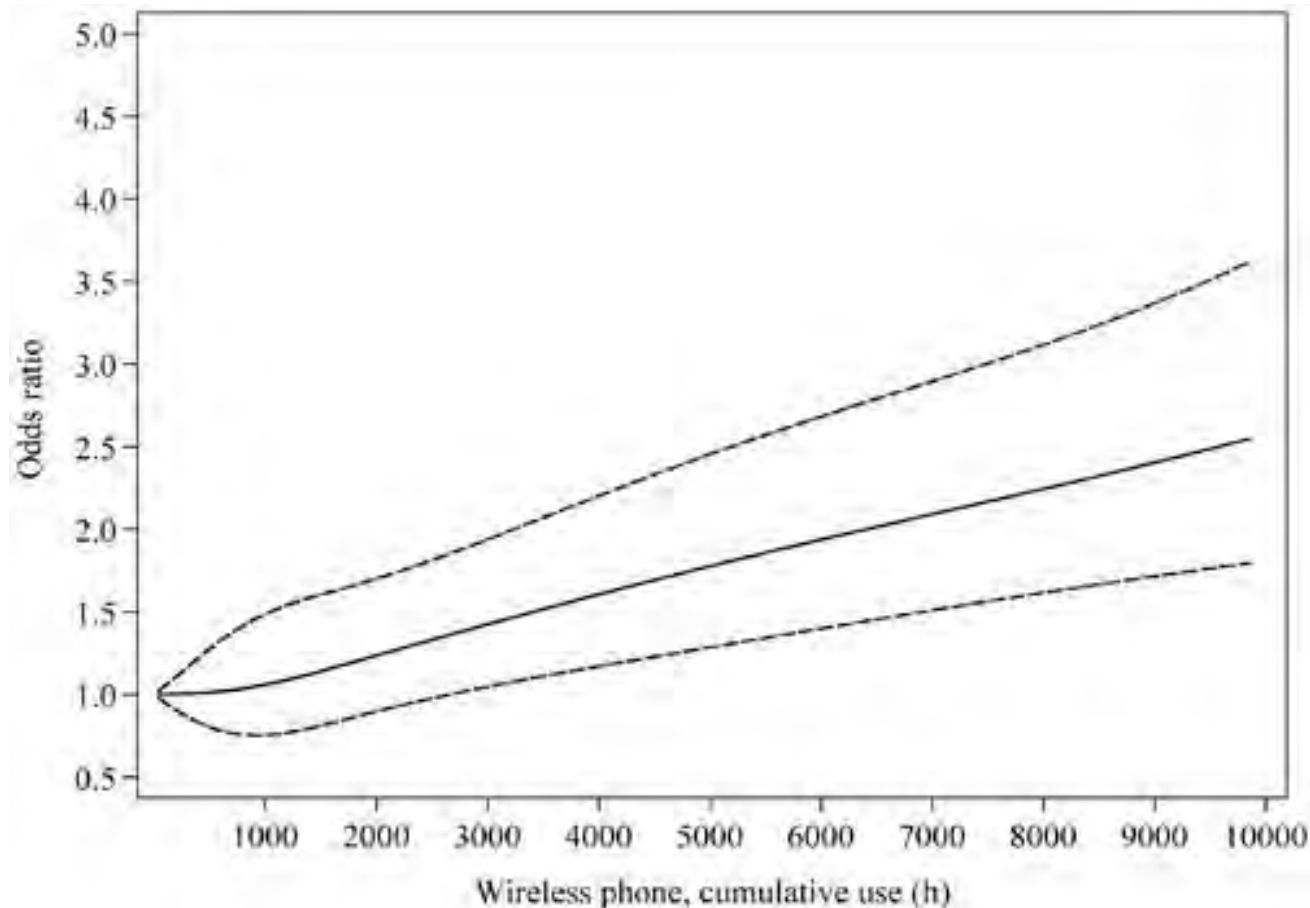
# Supplementary Slides



# Research Supplement



**Risk of glioma from wireless phone use (Hardell, 2013)**





# Hardell research group: Case-control studies since IARC



- Wireless phone use 25+ years
  - Glioma: OR = **3.3** (95% CI: 1.6 – 6.9)
- Wireless phone use 20+ years
  - Acoustic neuroma: OR = **4.4** (95% CI: 2.2 – 9.0)

Hardell et al. *Int J Oncology*. 43:1833-1845. 2013.

Hardell et al. *Int J Oncology*. 43: 1036-1044. 2013.

# U.S. - increases in brain tumor incidence over time



- Glioma in frontal lobe in adults 20 - 29 years old
- GBM in frontal & temporal lobes & cerebellum (overall population)
- Malignant brain & central nervous system tumors among children (0 - 14 years old)
- Non-malignant meningioma & pituitary tumors among children, adolescents & young adults (0 - 39 years old)

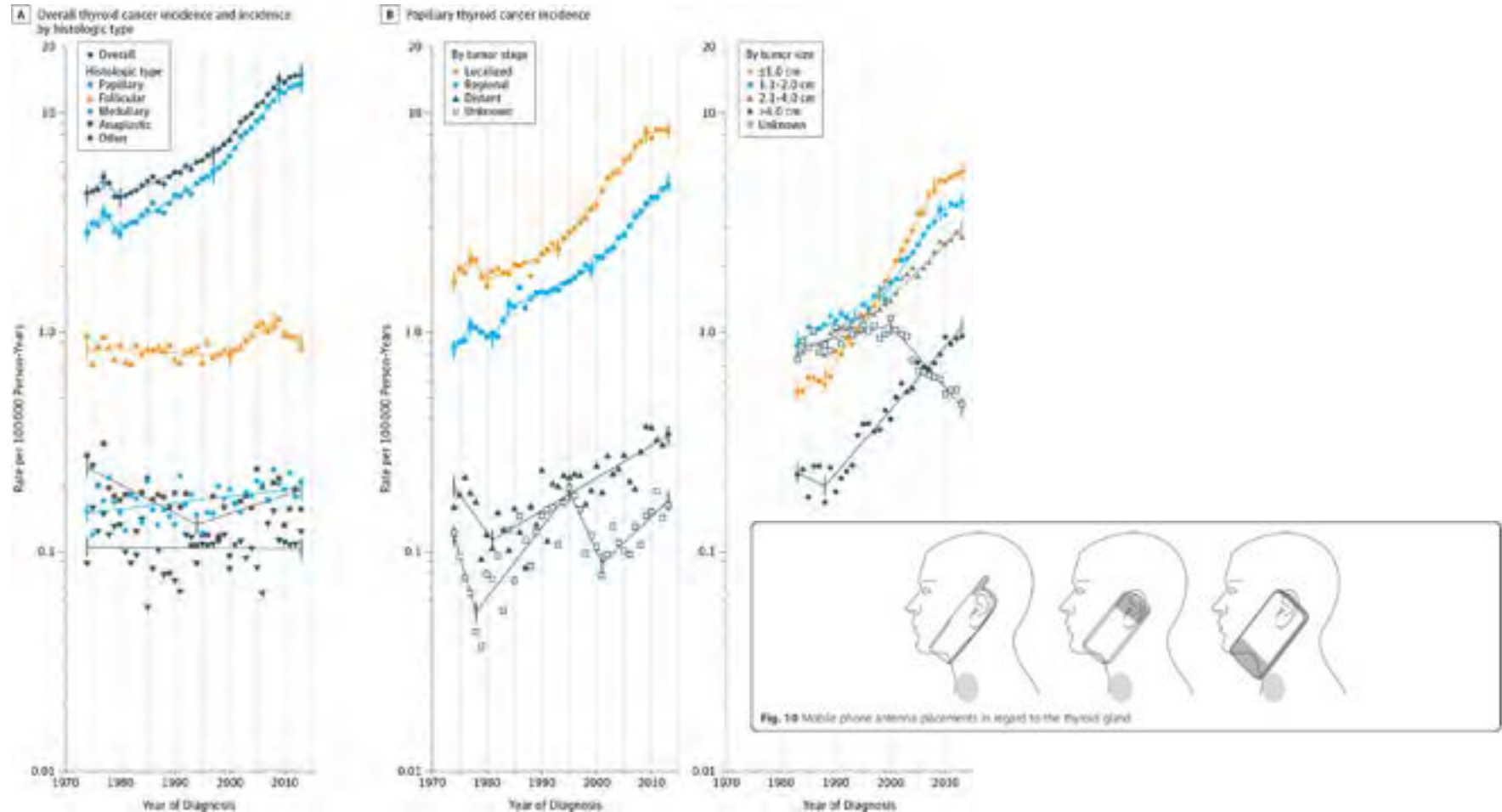
<http://bit.ly/risingtumors>

# Other nations - increases in brain cancer incidence over time



- **Netherlands, Norway & Finland:** overall
- **Australia & New Zealand:** over age 70
- **Sweden:** overall increase in inpatient registry but not tumor registry
- **England:** frontal & temporal lobes overall; GBM (glioblastoma) overall
- **Netherlands, Denmark, Australia:** GBM overall

# Thyroid cancer trends & smart phone use



Luo et al (2019). Cell phone use and risk of thyroid cancer: a population-based case-control study in Connecticut.

<http://bit.ly/saferEMRthyroid>





# Biological mechanisms

- Pall (2013) review paper
  - ELF & RF stimulate voltage-gated calcium channels to increase intra-cellular calcium ions & nitric oxide synthesis
  - Calcium channel blockers eliminate EMF-induced effects (23 studies)
- Leif Salford - blood-brain barrier penetration
- Other mechanisms
  - <http://bit.ly/cellphonestudies>

# Oxidative stress from **low-intensity** radiofrequency radiation



## **Yakymenko et al. (2015) review**

- Oxidative stress = imbalance between free radical production & body's ability to counteract harmful effects via antioxidants
- Effects = disrupted cell signaling, stress proteins, free radical formation, DNA-damage → carcinogenicity, neurologic disorders (e.g., electrosensitivity, ADHD)
- 93 of 100 studies (73 animal/plant, 16 cell samples, 4 human studies) → significant evidence of oxidative stress

# Three-fourths of studies find significant biologic effects



## Results of 537 Biologic Studies of the Effects of Radiofrequency Radiation Exposure Dr. Henry Lai, University of Washington

Outcome	Number of Studies w/ Significant Effects	Number of Studies w/ No Significant Effects
Neurologic	170 (71%)	71 (29%)
Genetic	84 (66%)	41 (34%)
Free Radical	152 (89%)	19 (11%)
Overall	406 (76%)	131 (24%)

# Early research results varied by funding source



## Industrial Support of Cell Phone Research

Funding	Effect	No Effect	Total
Industry	27 (32%)	57 (68%)	84
Non-industry	96 (70%)	41 (30%)	137
Total	123 (56%)	98 (44%)	221

$\chi^2 = 28.83$  ( $p < .001$ ) (1/27/05)

(Compiled by Prof. Henry Lai, Univ. Washington)



# U.S. - Major cell phone radiation studies



- 1993 – Wireless industry (CTIA) funded 7-year, \$28 million project
  - FDA co-sponsored study but dropped out
  - No peer-reviewed results published
- 1999 – FDA proposed \$10 million project
  - Study effects of 2G cell phone radiation on mice & rats
  - 2005 – Study initiated by National Toxicology Program
  - 2016 – Partial results released
  - 2018 – Final results released
  - \$30 million cost

# Policy Supplement



# Precautionary principle



“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Principle 15. Report of the U.N. Conference  
on Environment and Development  
(Rio de Janeiro, 1992)



# European Union: Policy recommendations



- **Governments:** adopt more stringent radiation standards & fund research ([European Environment Agency](#) [EEA], 2011)
- **Manufacturers:** improve cell phone design & issue warning labels (EEA, 2011)
- **Consumers:** reduce exposure (especially children); hands-free use (EEA, 2011)
- **Schools:** restrict Wi-Fi & mobile phone use ([Council of Europe](#), 2011)



# FDA called for more research in 1999



- “The existing exposure guidelines are based on protection from acute injury from thermal effects of radiofrequency radiation exposure, and may not be protective against any non-thermal effects of chronic exposure.”
- “A significant research effort is needed... to provide the basis to assess the risk to human health of wireless communications devices.” <http://1.usa.gov/1Mzz6UM>

# Consumer Reports magazine

## November, 2015 issue



- Cell-phone **manufacturers** should prominently display advice on how to reduce cell-phone radiation exposure.
- Consumers Union agrees with the the U.S. General Accountability Office (2012) & American Academy of Pediatrics (2013) that **FCC** should develop new cell phone tests that account for children's vulnerability because children's brains absorb more radiation.

# Massachusetts: Pending wireless safety legislation



- [S.107](#) Provide RF notifications on wireless devices
- [S.108](#) Disclose safe use of handheld devices by children on product packaging
- [S.1268](#) Commission to examine EMF health impacts
- [S.1864](#) Allow consumers to retain non-wireless radiation-emitting meters at no-cost
- [H.2030](#) Wireless management practices in public schools & colleges
- [S.2079](#) Reduce EMF exposure in schools
- [S.2080](#) Increase medical awareness & insurance coverage of non-ionizing radiation injuries



# RF exposure limits

## International Radio Frequency "RF" Exposure Limits for 1800 MHz Range

(Cell Phone, WiFi, Smart Meters, etc)

Location	Reference	Exposure time	Limit Based On	Lower by	$\mu\text{W}/\text{m}^2$	V/m
Most of Western Europe	IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
USA	(FCC) IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
Canada	Safety Code 6, Table 5 (2015)	6 minutes	Thermal / Heating	66 x	4,393,278.4	40.7
Russia	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
China	UDC 614.898.5 GB 9175 -88	3 hours +	Biological Effects	100 x	100,000	6.14
Italy	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
Most of Eastern Europe	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
Switzerland	Ordinance on Protection from Non-ionising Radiation (NISV)	Long Term	Precautionary	100 x	100,000	6.14
Toronto Board of Health, Canada	Proposed 1999	Long Term	Precautionary	100 x	100,000	6.14
Bio-Initiative Report recommendation	Bio-Initiative Report 2007	Long Term	Biological / Precautionary	10,000 x	1,000	0.614
Salzburg Resolution on Mobile Telecommunication	Preventive public health protection, Salzburg, June 7-8, 2000	Long Term	Precautionary	10,000 x	1,000	0.614
European Parliament	Resolution 1815, Strasbourg, May 27, 2011	Long Term	Precautionary	10,000 x	106	0.2
Building Biology Guidelines Germany (Sleeping Areas)	SBM2008 - Level of No Biological Concern	Long term	Precautionary	100,000,000 x	0.1	0.006,14
Cell Phone Operational Requirements				10,000,000,000 x	0.001	0.000,061,4
Natural Cosmic Radiation	MAES 2000	Long Term	Natural Exposure	10,000,000,000,000 x	0.000,001	0.000,000,061,4
Average Indoor Urban Exposure Toronto, Canada	Safe Living Technologies Inc. 2011	Long Term			200 - 5000	0.3 - 1.4



# Education Supplement



## TIPS TO REDUCE YOUR WIRELESS RADIATION EXPOSURE

### WHERE & WHEN

**Keep a distance.** Avoid holding your cell phone or cordless phone near your head or body during phone calls. Don't carry your cell phone in your pocket, in your bag, or close to your body when it is powered on. Especially keep the phone away from your head and reproductive organs. Use speakerphone, text, or email whenever possible. Avoid talking longer than necessary.

**Wait for a good signal.** When the signal is poor, your wireless signals send more power so avoid use when receiving a signal such as in an elevator, at a hotel, or while traveling in subways, tunnels, trains or aircraft.

**Reduce secondhand exposure.** Reduce the time you spend in locations where many people are using cell phones or other wireless devices. Avoid standing in close proximity to each other, especially in public transit.

**Turn off wireless devices at bedtime.** Turn off your cell phone, Wi-Fi router, and other wireless devices at bedtime and at other times when not in use.

### TAKE ACTION

**Minimize children's use & exposure to wireless radiation.** Children's health risks are greater so limit their use of cell phones and other wireless devices. Turn off Wi-Fi and cellular on devices used by kids. Teach children to use wireless technology safely.

**Pregnancy & fertility.** If you are pregnant or planning for a baby be especially careful as wireless radiation exposure is linked to reproductive health effects and also to sperm damage. Do not use a wireless tablet or laptop in your lap.

**Use airplane mode.** Turn off cell phones and other wireless devices when not in use or switch to Airplane Mode. Turn off Wi-Fi and Bluetooth when not in use.

**Use wired connections.** Use a wired, land line phone whenever possible. Forward cell phone calls to your land line and check on them when you get home. Use wired internet connections.

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Center for Family and Community Health  
School of Public Health  
University of California, Berkeley

**Electromagnetic Radiation Safety**  
Website: <http://www.cafch.org>  
Facebook: <http://www.facebook.com/CalEMR>  
News Release: <http://pressroom.berkeley.org/jmw1112/>  
Twitter: @cafchorg

**Electromagnetic hypersensitivity.** If you think you are developing allergic symptoms from wireless radiation exposure, keep a log of your exposures and your symptoms. Then reduce your exposure for two weeks, and see if your symptoms are reduced. Discuss the results with your healthcare provider.

**Governmental action is essential.** Send the International EMF Scientist Appeal ([EMFscientist.org](http://EMFscientist.org)) to your elected representatives. Ask them to adopt policies to make wireless technology safer. Encourage them to fund education and research through a modest fee on mobile device subscriptions (e.g. a nickel a month). Work with others to get schools to remove Wi-Fi and provide students with internet access via wired networks.

Journal of Environmental and Occupational Medicine • California Department of Public Health

## How to Reduce Exposure to Radiofrequency Energy from Cell Phones

### How can you reduce your exposure?

Keep your phone away from your body. Keeping your phone just a few feet away from you can make a big difference.

- When you talk on your cell phone, avoid holding it to your head—use the speakerphone or a headset instead. Wireless (Bluetooth) and wired headsets limit radiation RF energy from cell phones.
- Send text messages instead of talking on the phone.
- If you are streaming or if you are downloading or sending large files, try to keep the phone away from your head and body.
- Carry your cell phone in a backpack, briefcase, or purse; NOT in a pocket, bag or belt holder. Encourage your phone's antenna to stay connected with a cell tower whenever it's on. It emits more RF energy when you are not using it. It does not emit RF energy when it's in airplane mode. (Airplane mode turns off cellular, Wi-Fi, and Bluetooth.)

**Resist or avoid using your cell phone when it is sending out high levels of RF energy.** This happens mostly when:

- You see only one or two bars displayed: Cell phones put out more RF energy to connect with cell towers when the signal is weak. If you must use your phone when the signal is weak, try to follow the other guidance on this page.
- You are in a fast-moving car, bus, or train: Your phone puts out more RF energy to maintain connections to avoid dropping calls as it switches connections from one cell tower to the next unless it is in airplane mode.
- You are streaming audio or video, or downloading or sending large files: To watch movies or listen to podcasts on your phone, download them first, then watch or listen in airplane mode when you watch or listen.

Don't sleep with your phone in your bed or near your head. Unless the phone is off or in airplane mode, keep it at least a few feet away from your head.

Take off the headset when you're not on a call. Headsets release small amounts of RF energy even when you are not using your phone.

### What about children?

Children's health risks are greater so limit their use of cell phones and other wireless devices. Turn off Wi-Fi and cellular on devices used by kids. Teach children to use wireless technology safely.

- RF energy increases as you get closer to a child's head than an adult's head.
- A child's brain is still growing and developing through the teen years. During this time, the body may be more easily affected by RF energy. Some effects may be irreversible and long-lasting.
- A child who uses a cell phone with headphones is more exposed to RF energy in his or her head than an adult who uses a cell phone without headphones.

There is not a lot of research about the effects of cell phone RF energy on children's brains, but a few studies have shown that there may be hearing loss or ringing in the ears, headaches, and decreased general well-being.

<http://bit.ly/CDPHtips3>

<http://bit.ly/EMRsafetyTips>





# FDA safety tips



## Reducing Exposure: Hands-free Kits and Other Accessories

[SHARE](#) [TWITTER](#) [LINKEDIN](#) [PIN IT](#) [EMAIL](#) [PRINT](#)

### Steps to reduce exposure to radiofrequency energy

If there is a risk from being exposed to radiofrequency energy (RF) from cell phones--and at this point we do not know that there is--it is probably very small. But if you are concerned about avoiding even potential risks, you can take a few simple steps to minimize your RF exposure:

- Reduce the amount of time spent using your cell phone
- Use speaker mode or a headset to place more distance between your head and the cell phone

### Hands-free kits

Hand-free kits may include audio or Bluetooth headsets and various types of body-worn accessories such as belt-clips and holsters. Combinations of these can be used to reduce RF energy absorption from cell phone.

Headsets can substantially reduce exposure since the phone is held away from the head in the user's hand or in approved body-worn accessories. Cell phones marketed in the U.S. are required to meet RF exposure compliance requirements when used against the head and against the body.

Since there are no known risks from exposure to RF emissions from cell phones, there is no reason to believe that hands-free kits reduce risks. Hands-free kits can be used for convenience and comfort. They are also required by law in many states if you want to use your phone while driving.

### Cell phone accessories that claim to shield the head from RF radiation

Since there are no known risks from exposure to RF emissions from cell phones, there is no reason to believe that accessories that claim to shield the head from those emissions reduce risks. Some products that claim to shield the user from RF absorption use special phone cases, while others involve nothing more than a metallic accessory attached to the phone. Studies have shown that these products generally do not work as advertised. Unlike "hand-free" kits, these so-called "shields" may interfere with proper operation of the phone. The phone may be forced to boost its power to compensate, leading to an increase in RF absorption.

# CDC safety tips



Centers for Disease Control and Prevention  
CDC 24/7: Saving Lives. Protecting People™

## Radiation and Your Health

If you are worried about cell phone use, follow the tips below.

### Cell phone tips

To reduce radio frequency radiation near your body:

- Get a hands-free headset that connects directly to your phone.
- Use speaker-phone more often.
- In the past, RF interfered with the operation of some pacemakers. If you have a pacemaker and are concerned about how your cell phone use may affect it, contact your health care provider.

# NCI safety tips



**NATIONAL CANCER INSTITUTE**

## **What can cell phone users do to reduce their exposure to radiofrequency radiation?**

The FDA has suggested some steps that concerned cell phone users can take to reduce their exposure to radiofrequency radiation (49):

- Reserve the use of cell phones for shorter conversations or for times when a landline phone is not available.
- Use a device with hands-free technology, such as wired headsets, which place more distance between the phone and the head of the user.

Hands-free kits reduce the amount of radiofrequency radiation exposure to the head because the antenna, which is the source of energy, is not placed against the head (40). Exposures decline dramatically when cell phones are used hands-free.

<http://bit.ly/NCIcellphonecancerrisk>





# Consumer Reports safety tips



Does Cell Phone Use Cause Brain Cancer? What the New Study Means For You

Specifically, Consumer Reports recommends that you:

- Try to keep the cell phone away from your head and body. Keeping it an arm's distance away significantly reduces exposure to the low-level radiation it emits. This is particularly important when the cellular signal is weak—when your phone has only one bar, for example—because phones may increase their power then to compensate.
- Text or video call when possible, because this allows you to hold the phone farther from your body.
- When speaking, use the speakerphone on your device or a hands-free headset.
- Don't stow your phone in your pants or shirt pocket. Instead, carry it in a bag or use a belt clip.

# Documentary Films



[mobilizemovie.com](http://mobilizemovie.com)  
[bit.ly/mobilizefilm](http://bit.ly/mobilizefilm)



[generationzapped.com](http://generationzapped.com)  
(2017)