5G and the Internet of Things
Human Health and Environmental Issues

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Devra Davis, PhD, MPH

• Founding Director Board on Environmental Studies and Toxicology, National Research Council, National Academy of Sciences 1983-93 (group advising bans on indoor smoking)
• Member of Team Awarded Nobel Peace Prize with Al Gore as a Lead Author of the Intergovernmental Panel on Climate Change, 2007
• Bi-partisan Senate confirmation as Presidential Appointee 1994-99, numerous testimonies to U.S. Congress
• Advisor to Centers for Disease Control, World Health Organization, London School of Hygiene and Tropical Medicine
• More than 220 technical publications, 11 edited monographs, 3 popular books
• University of Chicago, 1967-71, PhD in Science Studies, Johns Hopkins University, 1981-82, MPH
Disconnect: The Truth About Cell Phone Radiation

- Decades of research documents serious biological effects.
- Government limits (FCC and ICNIRP) are outdated and non-protective—not followed in Israel & India.
Cell Phone Radiation Exposure Limits
Unchanged since 1996

- Account only for short term heating effects.
- Tests use a plastic dummy of a large male NOT relevant to children or smaller adults.
- Test for heat not relevant to impacts to the developing brain.
- ICNIRP is an invite-only organization lacking transparency with longstanding industry ties.
Children’s Deeper Absorption of Cell Phone Microwaves

Thinner skulls, smaller heads/ears and higher dialectical properties result in proportionately higher exposures.


RF energy deposition is 2 times higher in the brain and 10 times higher in the bone marrow of the skull, compared to adults.


Fernandez 2018:
Younger models absorb proportionally more radiation in eyes and brain – gray matter, cerebellum and hippocampus.

- Eyes 2 to 5 fold higher
- Up to 30 fold greater hippocampus

Ten is now the medium age that children are given smartphones.

Cell Phone Microwaves Absorbed into Six Year Old Child

Yellow = Highest intensity of absorption rate.
SAR in 6 Year Old from 2.45 GHz Wi-Fi Tablet

Tablet at 150 mm (5.9 inches) from eye lens

Fig. 7. Radiation pattern normalized to 0.0132 W/g = 0 dB, with a 30 dB color scale, and SAR averaged over 1g cube tissue.

Specific Absorption Rate (SAR) in the head of Tablet user's
RF Phone Radiation Exposes Male Reproductive System to Highest Exposures

“It’s best to keep your cell phone as far from the testes as you can,”
- Cleveland Clinic, 2016

Shahin et al., 2014
Recent Research (Animal and Human) Confirms Wireless is a Human Carcinogen

2011 RFR classified as “possible” carcinogen by WHO/IARC.

Published reviews conclude RFR is human carcinogen (Hardell et al., 2017, Miller et al., 2018)

2020 WHO/IARC advisory committee recommends RFR be re-evaluated.

- 2016 and 2018 National Toxicology Program study “Clear evidence of cancer”
- Ramazzini study of RFR with exposures of much lower levels (within FCC limits) than NTP

2020 Publications:
- 4 fold increases in colorectal cancer in young adults could be due to cell phones in the pocket (Miller et al 2020)
- Increases in primary central nervous system lymphoma could be linked (Hardell et al 2020)
The Scientific Evidence Indicates Wireless Radiofrequency Radiation is a Human Carcinogen

Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)∗

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ABSTRACT

Epidemiology studies (case-control, cohort, time trend and case studies) published since the International Agency for Research on Cancer (IARC) 2011 categorization of radiofrequency radiation (RFR) from mobile phones and other wireless devices as a possible human carcinogen (Group 2B) are reviewed and summarized. Glioma is an important human cancer found to be associated with RFR in 9 case-control studies conducted in Sweden and France, as well as in some other countries. Increasing glioma incidence trends have been reported in the UK and other countries. Non-malignant endpoints linked include acoustic neuroma (vestibular Schwannoma) and meningioma. Because they allow more detailed consideration of exposure, case-control studies can be superior to cohort studies or other methods in evaluating potential risks for brain cancer. When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1). Opportunistic epidemiological studies are proposed that can be carried out through cross-sectional analyses of high, medium, and low mobile phone usage.
RF Below Safety Limits Promotes Tumors
Mice: 24/7 RF Exposure, In Utero (A Replication Study)

- Higher liver and lung tumors
- 2.5 fold increases in lymphoma
- Nonlinear effect “may be due to metabolic changes”
  “Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones”

Lerchl 2015
Cancer is the tip of the iceberg

Published research on EMFs
- DNA damage
- Memory/Brain damage
- Sperm/Reproduction damage
- Synergistic effects
- Headaches
- Oxidative Stress
- Bees and insects
- Trees
5G mmWave Deployment Increases Ambient Radiofrequency Radiation

"The remarkable increase in radiation levels after integrating 5G infrastructure with the original LTE network can be easily observed through the predominance of the red color in the heat map."

"This suggests that 5G mobile networks cannot yet be classified as safe for the public, and demands serious considerations before using mmWave communications for 5G networks, given the potential harms it could afflict on the public."

A. M. EL-HAJJ AND T. NAOUS, “RADIATION ANALYSIS IN A GRADUAL 5G NETWORK DEPLOYMENT STRATEGY,” 2020 IEEE 3RD 5G WORLD FORUM (5GWF)
Impact of RFR on DNA damage & antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations*

- Study evaluated the effect of radiofrequency radiation from mobile phone base stations. Compared residents- matched for demographics.
  - Exposed group: Within 80 meters
  - Control group: Over 300 meters
  RF measurements ensured all RF levels were below India’s limits (1/10 of ICNIRP)

Significant biological effects found on individuals closer to mobile base stations (within 80 meters).
  - Alteration in antioxidant status in the plasma of exposed individuals
  - Decreased glutathione concentration, activities of catalase, superoxide dismutase
  - Increase in lipid peroxidation

** *Zothansiama et al. 2017*
Wireless Radiation Impacts the Brain
Research Finds Memory Damage, Behavior Problems, Hyperactivity

- Decreased and damaged brain cells in animals exposed as adults and prenatally
- Impacts to blood brain barrier
  (Nittby, 2010, Sirav and Seyhan, 2011)
- Altered brain activity - NIH
  (Volkow et al, 2011).
- Decreased memory in teens
  (Foerster et al, 2018).
- Decreased memory and hyperactivity after prenatal exposure- Yale
  (Aldad et al., 2011).
- Behavioral problems after pre/post natal -University of California School of Public Health
  (Divan et al., 2008, 2012).
- Hyperactivity/inattention problems in children after prenatal exposure
  (Birks et al., 2017)
Experimental Animal Studies with RFR and Wi-Fi Networks

National Toxicology Program
• Significant increases in DNA damage in frontal cortex of male mice, in blood of female mice (1,900 MHz) and hippocampus of male rats (900 MHz).  
  (Smith Roe et al., 2020)

Afe Babalola University, Nigeria
• Vascular congestion, DNA damage in brain tissue, decrease in AChE activity and increase in anxiety levels  
  (Ibitayo et al 2017, Obajuluwa et al. 2017)
• Alterations in hematological and biochemical parameters  
  (Bamikole et al, 2019)

Medical School of Dicle University, Turkey:
• Increased sperm head defects and decreased weight of reproductive organ tissues.  
  (Dasdag 2015)
• Altered expression of some miRNAs (miR-106b-5p and miR-107)  
  (Dasdag 2015)

“Conclusion: Long-term exposure of 2.4 GHz RF may lead to adverse effects such as neurodegenerative diseases originating from the alteration of some miRNA expression…”  
  (Dasdag 2015)
“In summary, the majority of the animal and more than half of the cell studies provided evidence of increased oxidative stress caused by RF-EMF or ELF-MF.”

“Pre-existing conditions, such as immune deficiencies or diseases (diabetes, neurodegenerative diseases), compromise the body’s defence mechanisms, including antioxidative protection, and it is therefore possible that individuals with these conditions experience more severe health effects. In addition, the studies show that very young and elderly individuals can react less efficiently to oxidative stress induced by EMF, which of course also applies to other stressors that cause oxidative stress.” (bold added)
Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body

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ABSTRACT In our publications, we have shown both from measurements and computer modeling that the specific absorption rate (SAR) reduces by 10%–15% for every millimeter separation of the cell phone on account of rapidly diminishing EM fields in the near-field region of the cell phone antenna. This rapid reduction of SAR depending on the antenna and its location on the handset has been shown, both computationally and experimentally, regardless of the phantom model such as a flat phantom suggested for SAR compliance testing of devices in contact with the body, for a sphere phantom, and for head-shaped models used for SAR compliance testing of cell phones. Unfortunately, our observations in the past were based on SARs of only three cell phones. Expecting that the SARs for cell phones may exceed the safety limits for body contact, cell phone manufacturers have started to recommend that the devices can be used at 5–25 mm from the body even though it is difficult to see how to maintain this distance correctly under mobile conditions. The National Agency ANFR of France recently released the cell phone SAR test data for 450 cell phones that measure 10-g SARs reducing by 10%–30% for each millimeter distal placement from the planar body phantom. Their data corroborate our findings that most cell phones will exceed the safety guidelines when held against the body by factors of 1.6–3.7 times for the European/ICNIRP standard or by factors as high as 11 if 1-g SAR values were to be measured as required by the U.S. FCC.

- Phones Violate ICNIRP Limits in Body Contact Positions
- French Agency ANFR SAR test data found most phones violate ICNIRP limits when tested in body contact positions (Phonegate)
- 17+ Phone models in France taken were either software updated or removed from market.
- Gandhi 2019 study finds the FCC equivalent of ANFR data = phones could have measured SARS up to 11 times FCC limit.
Microwaves Can Damage Blood Brain Barrier and Other Membranes

Every cell has a membrane that is vulnerable to EMF exposure- including those in the reproductive system.

Control                                                RF Exposed

Several Research Studies:
Allan Frey-Annals of the New York Academy of Sciences 1975

Dr. Leif Salford , 2009

EHTrust.org
Use of laptops connected to Wi-Fi damages human sperm DNA

4 hours non thermal exposures cause significant damage

Fertility and Sterility  Avendano et al. 2012
A Meta-Analysis of In Vitro Exposures to Weak Radiofrequency Radiation Exposure from Mobile Phones (1990–2015)

*Environmental Research*, (Halgamuge, et al., 2019)

- 300 peer-reviewed scientific publications (1990–2015) describing 1127 experimental observations in cell-based in vitro models
- Out of 746 human cell experiments, 45.3% indicated cell changes, whereas 54.7% indicated no changes ($p < 0.001$)
- Higher impacts among faster-growing less differentiated cell types such as human spermatozoa and human epithelial cells
- 74.4% of faster-growing cells from other species (chicken, rabbit, pig, frog, snail) undergo significant changes from RF
- Study confirms observations of REFLEX project, Belyaev, and others that cellular response varies with signal properties
EMF-induced alterations in cellular levels can activate voltage-gated calcium channels and lead to the formation of free radicals, protein misfolding and DNA damage.

Rapidly dividing germ cells go through meiosis and mitosis, rendering them more sensitive to EMF.

Effects of EMF on reproductive functions depend on frequency and wave, polarity, information content, as well as energy, power density, and total time of exposure.

Altun et al. 2018
American Cancer Society Funded Study: Thyroid Cancer Increased Significantly with Regular Cell Phone Use in Certain SNPs, 2020

• Luo and colleagues (2020) at Yale University case-control study found doubled risk of thyroid cancer in those using phones for 1+ hour a day who also carried certain Single Nucleotide Excisions (SNP) affecting DNA repair

• Newer phones have antennas located closer to thyroid, which may account for part of the unexplained recent growth in this cancer especially in those under age 50

Luo 2020 “Genetic susceptibility may modify the association between cell phone use and thyroid cancer: a population-based case-control study in Connecticut”
Could the Increases in Colo-rectal Cancer in Young Adults be Tied to Cell Phone Radiation?

- 4-fold increase in rectal cancer in last decade in American young adults
- Colo-rectal cancer cells are exquisitely sensitive to RF
- Phones are ‘on’ and radiating into the abdomen unless turned to airplane mode or off
- Research has found that the effect of exposure to mobile phone radiation and 3Gy gamma radiation have similar impacts on treated colon tissues of rats compared to the controls

Davis et al., 2020 Increased Generational Risk of Colon and Rectal Cancer in Recent Birth Cohorts under Age 40 - the Hypothetical Role of Radiofrequency Radiation from Cell Phones published in Annals of Gastroenterology and Digestive Disorders
Hundreds of Scientists Call To Halt 5G, Reduce Public Health Exposure and Enact Environmental Protections

2020 Consensus Statement of UK/International Medical & Scientific Experts
5G Appeal to the European Union
EMF Scientist Appeal
International Society of Doctors for Environment
American Academy of Pediatrics
Alliance of Nurses for Healthy Environments
US Doctors Letter National 5G Resolution
60 Officials in France - Chile Medical Doctors - German Doctors Delegation
Vienna Medical Association - Athens Medical Association
Hippocrates Electrosmog Appeal of Belgium Doctors
Pancyprian Medical Association
Cyprus National Committee on the Environment and Child Health
Swiss Physicians Association of Doctors for Environmental Protection
And more at EHTRUST.org
"As a research scientist and physician who studies how microwave radiation affects the outcomes of pregnancy, I am deeply concerned about growing exposures to cell phone and other wireless radiation." - Dr. Hugh Taylor, Chief of Obstetrics at Yale

10 Tips to Reduce Exposure including:

• Avoid carrying your cell phone on your body
• Avoid holding any wireless device against your body when in use
• Whenever possible, connect to the internet with wired cables.
• When using Wi-Fi, connect only to download, then disconnect.
• Avoid prolonged or direct exposure to Wi-Fi routers

http://www.babysafeproject.org/
New Hampshire Commission on 5G Health and the Environment, 2020

- Final Report after one year of investigation
- Presentations by expert scientists & National Institute of Health
- 15 Recommendations to the state to protect the public and environment.
  - Support an independent study of 5G health effects.
  - Ensure cell network infrastructure antenna setbacks from schools and homes
  - Reduce exposure and require software changes to reduce radiation exposure into the body.
  - Replace Wi-Fi with hardwired connections in schools and libraries.
Educate the Public

Educate on how to reduce exposure to phones and all wireless devices.

Educate on 5G and densification of wireless antennas that will increase involuntary and ambient exposures day and night.

**Protect Yourself.**

**Cell Phones Expose Your Body to Radiation**

Research links this microwave radiation to:
- Damaged sperm
- Reduced sperm count
- Erectile dysfunction
- Memory problems
- Cancer

5G and 4G cell antennas will increase your daily dose of radiation. Not to mention, it will also impact the birds, bees and trees. Educate yourself on 5G.

All cell phones and wireless devices have fine print warnings hidden deep in manuals advising the device not be in contact with the body.

More at [EHTrust.org](http://EHTrust.org)

**Doctors’ Recommendations**

1. **Protect Your Body**
   Do not carry cell phones in your pockets or bra. No laptops or tablets on your lap.

2. **Protect Your Brain**
   Prefer a corded landline phone. Hold cell phones away from the head and body by using speakerphone.

3. **Protect Your Fertility**
   No wireless devices near reproductive organs or near a pregnant woman’s abdomen.

4. **Reduce Wireless**
   Turn off Wi-Fi and use cords to connect routers, phones, computers and other devices. Airplane Mode ON with Wi-Fi OFF turns off wireless.

5. **Do Not Sleep With Your Cell Phone**
   Cell phones and Wi-Fi devices are radiating even when not in use. Power off all devices at night, and keep them out of the bedroom.
Environmental Health Trust Resources

Do's and Don't's for Safe Technology at Home

Minimize health risks from electronic devices

Questions and Answers about Wi-Fi in Schools

Protect the ones you love.

What Parents Need to Know About Safe Technology

Social Media Graphics to Share

Questions and Answers on Wi-Fi and Cell Phones in Schools

New Jersey Educational Association PDF

Postcards for printing

DID YOU KNOW...

YOUR CELL PHONE EMITS MICROWAVE RADIATION.

Cell phones and wireless devices are two way microwave radios.

Consumer Reports recommends that you keep your cell phone away from your brain and body. Give your brain a break. Use speaker mode or an airtube headset.

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Posters on Safe Technology

Cell Phones

 вместе

Questions and Answers on Wi-Fi and Cell Phones in Schools

Protect the ones you love.

Social Media Graphics to Share

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