

### What are the health effects of EMFs?

EMF is a possible human carcinogen; reducing chronic exposures may reduce health risks.

Exposures to **electromagnetic fields from electrical appliances and gadgets** (ELF-EMF) are linked to increased risk for cancers including breast cancer, leukemia and brain tumors; plus neurological diseases like Alzheimer's disease and amyotrophic lateral sclerosis (ALS, also known as Lou Gehrig's disease).

**Radiofrequency (RF) radiation** exposure from cell and cordless phones is linked to increased risk for malignant brain tumors and acoustic neuromas. Exposure to RF from cell towers, Wi-Fi and dirty electricity is linked to headache, dizziness, nausea, fatigue, cardiac problems, ringing in the ears (tinnitus), sleep disruption, memory and concentration problems, digestive problems, immune dysfunction, worsened asthma and allergy symptoms including skin rashes and worsening of inflammatory conditions, joint and muscle pain, and disruptions of normal blood sugar levels.

Increased risk of brain tumor (glioma) starts at only 260 hours of cumulative lifetime exposure to cellular/cordless phones. Risks more than double when phones have been used for 10 years or longer, with ipsilateral use (when the phone is used mainly on one side of the head) and 2000 or more hours of lifetime use. Risks are highest for the 20-29 age group. At 1640 cumulative lifetime hours of combined cell and cordless phone use, the risk for glioma is nearly doubled in adults with 10 years or more of use and with ipsilateral use.

*For more information, please see the 2007 BioInitiative Report: A rationale for a biologically-based public exposure standard for electromagnetic fields (ELF and RF), available online from the BioInitiative Working Group, [www.bioinitiative.org](http://www.bioinitiative.org).*

*by Cindy Sage, MA, and Nancy Evans, BS  
for the CHE EMF Working Group, November 2011*

This is a quick guide to the major sources of electromagnetic fields (EMF) in everyday life, as well as some suggestions about how to avoid unnecessary EMF.

### Where do EMFs come from? Should I be concerned?

This fact sheet addresses two types of electromagnetic fields, including dirty electricity:

- **Extremely low frequency electromagnetic fields (ELF-EMF)** are generated from appliances and other items that use electricity (power-frequency fields).
- **Radiofrequency (RF-EMF)** is generated by wireless technologies such as cellular and cordless phones.
- **“Dirty electricity”** is a term used to describe low-kilohertz frequency fields that can be thought of as an unintentional RF pollutant on electrical wiring and into living space. Power is “dirty” or polluted when it contains the high frequency signals flowing through overloaded wires, and not just the clean 60 Hz power that's created at the source.

People with special vulnerability to carcinogenic and neurotoxic exposures can reduce their exposures in the home, at school, at workplaces and in public places.

Vulnerable individuals include

- pregnant women and their developing babies
- children, particularly children with autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD) or attention deficit disorder (ADD)
- the elderly
- individuals with wireless medical devices, including wireless insulin pumps, defibrillators and pacemakers, which can be hacked or disabled by pulsed RF from other wireless sources
- any persons who have become sensitive to

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electromagnetic fields in general.

If you can identify sources, you can greatly reduce your exposures to ELF-EMF from power lines, appliances and home wiring; dirty electricity from

compact fluorescent bulbs (CFBs) and other sources; and from high frequency (wireless) sources of radiofrequency radiation.

## Sources of extremely low frequency [ELF-EMF] in the home, workplace and school environments:

- High-voltage transmission lines — large power lines on metal poles or towers — can produce elevated EMF (over 1 milligauss or mG). These elevated fields can extend several hundred to as much as 1000 feet on both sides. That's greater than the length of three football fields. Homes, schools and workplaces near these power lines can be within these high EMF zones.
- Pad-mounted ground transformers — big green boxes labeled "High Voltage" that sit outside buildings.
- Appliances (magnetic induction stovetops, microwave ovens, computers, washers and dryers, televisions, radios, etc.); EMF fields from these appliances penetrate through walls.
- Smart grid or "smart" wireless utility meters for electric, gas and water metering (switch-mode power supply produces ELF-EMF and dirty electricity).
- New appliances with radiofrequency power transmitters for wireless smart meters. Ask before purchase and choose brands without wireless power transmitters built in.
- Plasma televisions, which apparently have some adverse bioeffects on some people that are similar to exposures to wireless devices. LCD screen TVs have low or no EMF and are a better choice.
- Lighting — compact fluorescent bulbs (CFBs) and other fluorescent lighting.
- Electrical main panels, subpanels in the home, and electrical wiring in the walls, if improperly wired.
- Home grid systems that use the home's electrical wiring to transmit RF signal for wireless devices, known as broadband over power line (BPL).
- Electric and hybrid cars — EMF levels vary widely, so check if information on electric field exposure is available from the manufacturer before buying.
- Any transformer for charging power (little black boxes that connect appliances to wall outlets); "boom boxes" for music that plug into an electrical wall socket; power strips into which lots of wires are plugged.
- In classrooms, overhead projectors, slide projectors, and computer hard drives. A teacher standing near or under an overhead projector gets as much exposure as sleeping under an electric blanket.
- Offices or classrooms over or adjacent to switchgear rooms (electrical rooms) can have excessively high ELF-EMF exposures. Working on the first floor of a high-rise often places people directly over a switchgear electric room and excessive EMF.
- Personal digital assistants (PDAs such as BlackBerry and smart phones). These also produce very high bursts of ELF-EMF from the battery switching when on.
- Large electrical systems (electric motors, generators, electric cables).
- Power saws, drills, welding, or any variable-speed induction motor, such as a sewing machine.
- Electric transportation systems (trains) and light rail or magnetic levitation (maglev) trains.

## Sources of RF (radiofrequency, wireless) EMF in the home, workplace and school environments:

- Smart grid / “smart” wireless utility meters (switch-mode power supply; electric, gas or water). Electric utilities that “read” your electric meter remotely will attach a wireless transmitter on your wall. This transmits wireless RF constantly.
- Wireless baby monitors, which produce excessively high ELF-EMF and/or RF.
- Dimmer switches — rheostat lighting produces dirty electricity.
- Cordless phones, but especially iDEN cordless phones, a new US form of the European DECT phone. It emits a strong RF signal, and it radiates full power 24/7, unlike a regular cordless phone, which only radiates when in use.
- Wireless phones (all cellular phones, smart phones, Bluetooth, pagers), which emit pulsed RF. Low-level RF emissions are not necessarily much safer. No one can yet say what a lower safe limit is.
- Microcell wireless cellular boosters which amplify cell signals inside buildings.
- Citywide wireless systems, Wi-Fi hotspots, wireless systems installed by private businesses that can crisscross commercial streets and expose shoppers and pedestrians to invisible beams of pulsed RF.
- Cellular antennas on nearby buildings radiating to you, or cellular antennas on your building, radiating toward a nearby building with glass windows that reflect the RF back to you.
- In schools, cellular towers or antennas on campus or adjacent to campus. These may include hidden or “stealth” cell site installations built on the roof or inside a chimney or church steeple.
- Wireless networks, wireless access points, wireless laptops, plus wireless overhead projectors and white boards that are used for interactive learning in the classroom.
- FM transmitters worn by teachers in schools for hearing impaired students produce excessively high RF exposures for chronic exposure. They can be placed nearby on a desk instead.
- Radiofrequency identification (RFID) and metal detector systems used in airports, stores, libraries and hospitals. RFID scanners are powerful and can disable medical implants.
- Broadband over power line (BPL) – a new technology that will use the existing electrical power grid to transmit an RF signal (wireless) for Internet access. It would expose all buildings with electrical wiring — all buildings with electricity — to constant RF, even if you do not buy the “black box” to decode and use it.
- Wireless headsets in stores; employers may require workers to wear transmitters on their bodies.
- Wireless sensors for transportation, parking and “FastTrack” uses.
- WiMAX, which has a 10- to 20-mile radius and is very strong near the tower antennas.
- Broadcast towers: AM, FM and television towers.
- Radar. Doppler radars for weather are tremendously strong RF sources, creating intermittent, sweeping exposure at very high peak power. This includes radar at airports and military bases.
- Electronic Article Surveillance (EAS) systems in retail stores with security gates -- the flat white panels that are near the doors. These panels have some of the strongest known exposures in daily life. They are for detecting shoplifters who carry RF-tagged articles out of a store.

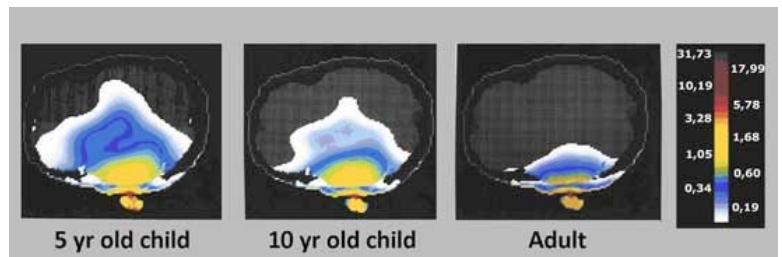
## Making wise choices

We recommend that you use a corded phone (land line) as your regular telephone.

If you need to use a cordless phone or cell phone, use a headset (wired only) whenever possible and/or use your phone on speakerphone. Text rather than talk. Keep your calls very brief, and hold your cell phone away from your head and body, especially when the phone is connecting your call.

**Children should not use cell phones or cordless phones.** Studies show children have a five-fold risk of malignant brain tumors in a shorter time than adults.

*Graphic used with permission from Gandhi OP, Lazzi G, Furse CM. Electromagnetic absorption in the human head and neck for cell telephones at 835 and 1900 MHz. IEEE Transactions on Microwave Theory and Techniques. 6;44(10):1884–1897.*



### Other recommendations:

- Avoid Bluetooth-type wireless headsets because of the chronic exposure from both the wireless headset and the phone you carry.
- Avoid wearing a cell phone or PDA (BlackBerry or smart phone) when “ON” because the battery-switching ELF emissions are excessively high, in addition to the RF emissions.
- Avoid using a cell phone in the car when children occupy the vehicle. RF levels will be unacceptably high in the back seat during cell phone use in the front seat.
- Avoid DECT or iDEN cordless phones. The “base” is always “ON” and transmitting. They are a large, continuous source of RF compared to other cordless phones.
- Promote wired (not wireless) alternatives for Internet access in your city. Citywide Wi-Fi causes involuntary exposures for everyone.
- Avoid hotels that have Wi-Fi (wireless hotspots) if you want to sleep well.
- Avoid wireless hotspots, particularly when with children. Let restaurants, Internet cafes, stores, libraries and hotels know if you object to involuntary exposure from wireless hotspots when you shop or travel.
- Choose wired Internet (Ethernet cable modems) at home instead of wireless systems, if possible. If you do use wireless systems, unplug them during sleeping hours. Install the wireless access points as far as possible from occupied space (your desk) and never in or near a child’s bedroom.
- Be aware of your school district’s facilities – do not support wireless. Since the World Health Organization’s International Agency for Research on Cancer has recently classified RF as a 2B possible human carcinogen, ask your schools to switch to cable and remove wireless Internet and its hot-spot access nodes.
- Classrooms should be fitted with RF filters to remove dirty electricity as a matter of routine hygiene. Educators should avoid standing over or near wireless networks, access points, laptops, overhead projectors and white boards. Stand or sit at least a few feet away from these sources when possible. Move your desk around, or move the devices away from you and your students.
- Wired cable connections are fine. Schools, especially classrooms for special education students, for children with autism (ASD) and

those with ADD and ADHD, should have classrooms that have no wireless exposures and have Graham-Stetzer RF filters to eliminate low-kilohertz frequency (dirty electricity) exposures.

- Educate yourself and your community about alternatives to wireless Internet (see *Wired Child* at [www.wiredchild.org](http://www.wiredchild.org) for more information).
- Do not use a laptop (a notebook computer) in your lap if it has a wireless card (for wireless Internet). The strength of the wireless emission is very high, similar to having a cell phone transmitting in your lap.
- Avoid multiple trips through security gates in retail stores. Never let children play between or linger near the panels. These panels create huge RF exposures.

- Medical MRI and ultrasound scans are sources of EMF and should be used only for diagnostic purposes where clearly indicated. Discuss the necessity of these exposures with your physician if one is recommended for you or your child.
- Use single-pole light switches and avoid dimmer switches (rheostat lighting).
- Avoid compact fluorescent bulbs (even though they are more energy efficient). Use LED or incandescent light bulbs. They emit no dirty power or low-kilohertz frequency RF back onto your electrical wiring.
- Position beds, desks and living space away from electrical panels in your home if possible.
- Check about opting out of “smart meter” service with your local utility if it’s being implemented.

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## What if I am pregnant or have small children?

- Avoid wireless communications devices (cellular and cordless phones, iPhones, BlackBerry and other similar devices); and ask others around you to keep their distance during use of a cell or cordless phone.
- Avoid using a cordless or cell phone or PDA when carrying an infant or small child.
- Avoid using wireless routers and wireless laptops. Cable Internet is fine.
- Avoid Wi-Fi zones for extended periods of exposure (work, home, school).
- Avoid electric heating (radiant ceiling or floor heating that is from electrical wiring); water heating in floors is fine.
- Avoid electric blankets and heating pads; if you use an electric blanket to preheat your bed, you must unplug it before sleeping and not just turn it off — the electric field is still generated whenever the item is plugged in, even if it’s turned off.
- Limit ultrasounds during pregnancy to those deemed medically necessary. Ultrasound uses pulsed sound waves and non-ionizing radiation to produce images, but both can heat tissue (a risk factor for the developing fetus and its nervous system and internal organs). There are studies reporting that the use of a cellular phone during pregnancy increases the risk for a child’s learning and behavior by the time they are in primary school.
- Do not give wireless devices to toddlers or children as pacifiers or distractors. Do not place a cell phone or smart phone in a crib to sooth a baby with music.
- Do not use baby monitors.
- Choose wired cable Internet to make Internet calls (such as through Skype) to the grandparents. Do not hold a wireless iPad or cell phone up to the face or body of an infant or child to talk or call over the Internet.

## What about cell phone use and driving?

In addition to concerns about RF from mobile phones, neither talking nor texting is safe while driving. For the safety of yourself, your passengers, and others sharing the road with you, we strongly encourage you to hang up and drive (laws in many

locations reinforce this). Do not return calls or texts while driving. Do not take calls while driving. Collect messages when you arrive at a safe spot. Get a built-in, hands-free car-phone jack and hook up the antenna outside the car, if possible.

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### **Additional resources**

- [www.bioinitiative.org](http://www.bioinitiative.org)
- [www.emrpolicy.org](http://www.emrpolicy.org)
- [www.emfsafetynetwork.org](http://www.emfsafetynetwork.org)
- [www.healthandenvironment.org/initiatives/emf](http://www.healthandenvironment.org/initiatives/emf)
- [www.ultrasound-autism.org](http://www.ultrasound-autism.org)
- [www.powerwatch.org](http://www.powerwatch.org)
- [www.wiredchild.org](http://www.wiredchild.org)

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### **More information about the scientific basis for this column can be found in these documents:**

- Sage C, Carpenter DO. (Eds.), (2007) *Bioinitiative Report: A rationale for a biologically-based public exposure standard for electromagnetic fields (ELF and RF)*. BioInitiative Working Group, [www.bioinitiative.org](http://www.bioinitiative.org)
- Sage C, Carpenter DO. (2009). Public Health Implications of Wireless Technologies. *Pathophysiology*. 16(2-3): 233-246.

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