Addressing cell towers at schools as primary prevention: the need for science-based policy to mitigate health and safety risks

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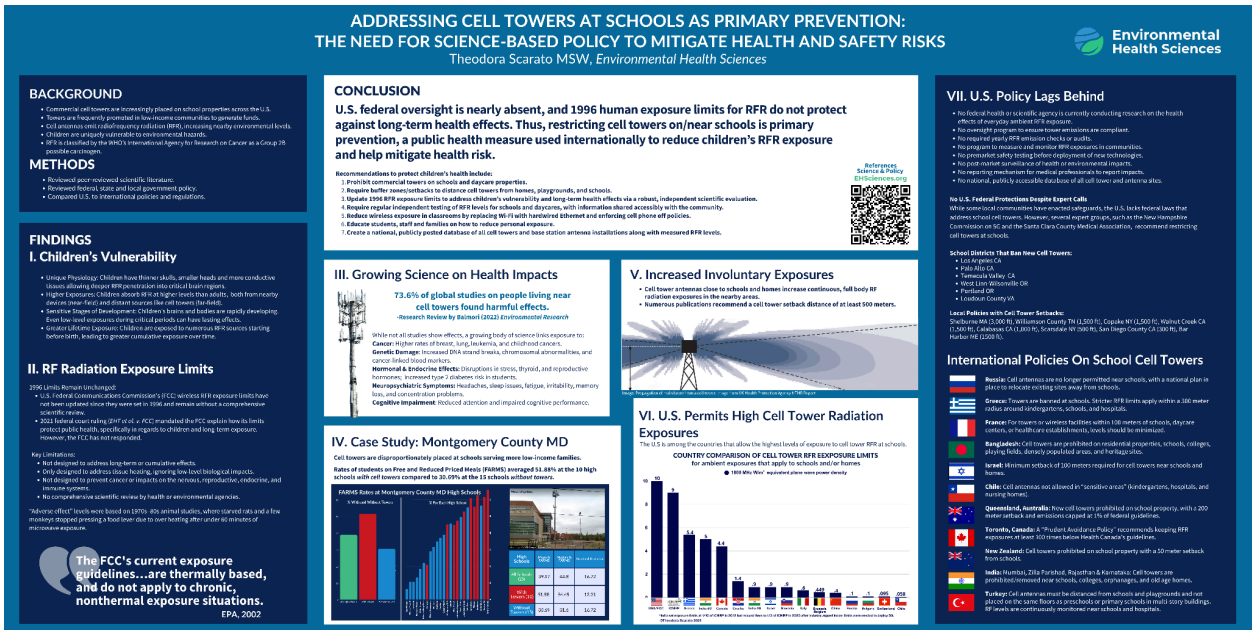

ABSTRACT

Background:
Across the United States, commercial cell towers are being placed on school properties, often without transparent community engagement and more often in low-income and minority communities. These installations raise significant public health, safety, and liability concerns—particularly for children, who are more vulnerable to exposure.

Methods:
This presentation synthesizes findings from peer-reviewed science, government and industry and case studies from school districts across the country detailing the health, safety and liability issues. It compares national and international policy positions.

Results:
Companies caution their shareholders of the liability risks from cell tower radiation and many

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even classify it as a pollutant, but do not inform school districts. Numerous scientists recommend cell towers are distanced 1,500 feet from schools. Research is ongoing but has reported a range of impacts- including cancer, neurological symptoms, and reproductive harm—associated with long-term, low-level cell tower radiation exposure, even at levels below government limits. Numerous school districts and local governments have adopted policies banning or restricting cell towers on or near school grounds but there is disproportionate siting in low-income and minority communities and a need for meaningful community engagement. Further, the US has among the most lenient federal regulations for cell tower radiation in contrast to the numerous countries which have limits up to 100 times stricter or have banned cell towers at schools altogether.

Conclusion:
Cell towers pose several health and safety risks to children, teachers and staff in schools that can be mitigated by science based setbacks and precautionary measures.

Learning Outcomes:

1. Identify the public health, safety, and equity risks associated with cell tower placement on or near school properties, including disproportionate impacts on low-income and minority communities.

2. Describe the science-based policy recommendations and international best practices in the scientific literature for reducing risk to children and school staff in school environments, including the implementation of precautionary setbacks.

BACKGROUND

- Commercial cell towers are increasingly placed on school properties across the U.S..
- Cell towers are frequently promoted in low-income communities to generate educational funds.
- Cell tower network antennas and small cell (5G and 4G) installations emit radiofrequency radiation (RFR), increasing nearby environmental levels.[1–6]
- Children are uniquely vulnerable to environmental hazards as their bodies and brains are still in development.[7–9]
- Wireless radiation RFR is classified by the WHO's International Agency for Research on Cancer as a Group 2B possible carcinogen.[10,11]

METHODS

- Reviewed peer-reviewed scientific literature on RFR and children's health.
- Reviewed federal, state and local government policy on cell tower school citing.
- Compared U.S. policy on cell tower radiation at schools to international policies and regulations.

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FINDINGS

I. Children's Vulnerability

- **Unique Physiology:** Children have thinner skulls, smaller heads and more conductive tissues allowing deeper RFR penetration into critical brain regions.[7,12–14]
- **Higher Exposures:** Children absorb RFR at higher levels than adults, both from nearby devices (near-field) and distant sources like cell towers (far-field).[7,14–25]
- **Sensitive Stages of Development:** Children's brains and bodies are rapidly developing. Even low-level exposures during critical periods can have lasting effects.[8,26–28]
- **Greater Lifetime Exposure:** Children are exposed to numerous RFR sources starting before birth, leading to greater cumulative exposure over time.

II. RF Radiation Exposure Limits

1996 Limits Remain Unchanged:

- The U.S. Federal Communications Commission's (FCC) wireless RFR exposure limits have not been updated since they were set in 1996 and remain without a comprehensive scientific review.[7,29,30]
- A 2021 federal court ruling (*EHT et al. v. FCC*) mandated the FCC explain how its limits protect public health, specifically in regards to children and long-term exposure. However, the FCC has not responded.[31]

Key Limitations:[29,30,32]

- Not designed to address long-term exposure or cumulative effects.
- Only designed to address tissue heating, ignoring low-level biological impacts.
- Not designed to prevent cancer or impacts on the nervous, reproductive, endocrine, and immune systems.
- No comprehensive scientific review by health or environmental agencies.

Adverse effect" levels were based on 1970s–1980s animal studies, where starved rats and a few monkeys stopped pressing a food lever due to overheating after less than 60 minutes of microwave exposure.[30]

"The FCC's current exposure guidelines…are thermally based, and do not apply to chronic, nonthermal exposure situations."- U.S. Environmental Protection Agency, 2002[33]

III. Growing Science on Health Impacts

73.6% of global studies on people living near cell towers found harmful effects.
-Research Review by Balmori (2022), *Environmental Research*[34]

While not all studies show effects, a substantial and growing body of science links RFR exposure to numerous effects. Studies measuring RFR levels show that proximity to cell towers or wireless base stations increases ambient exposure, which in turn is associated with a higher likelihood of observed effects.[35,36]

- **Cancer**: Higher rates of brain, breast, lung and leukemia cancers.[11,34,37–40,40–43]
- **Genetic Effects:** Increased DNA strand breaks, chromosomal abnormalities, increased micronuclei formation, and cancer-linked blood markers.[35,44–50]
- **Hormonal & Endocrine Effect**s: Disruptions in stress, thyroid, and reproductive hormones; increased type 2 diabetes risk in students.[34,51–56]
- **Neuropsychiatric Symptoms:** Headaches, sleep issues, fatigue, irritability, memory loss, and concentration problems.[36]
- **Cognitive Impairment:** Reduced attention and impaired cognitive performance.[52,57]

A large scale animal study published in *Environmental Research* by Falcioni et al. found elevated cancer rates in rats exposed to RFR at levels permitted for cell tower emissions.[38] The European Parliament commissioned report titled "Health Impact of 5G", concluded that widely used RF radiation frequencies (450–6000 MHz) are likely carcinogenic to humans and may harm male fertility and early development stages such as embryos and newborns.[58]

Study Highlight: Cell Tower Radiation Study Finds Cell Tower Exposures Can Be Higher Than Cell Phone Use For Children

Children's Brains Absorb More Cell Tower Radiation Than Adults

A 2023 study by Lee and Choi in *Environmental Research* found that continuous 24-hour radiation from cell towers (downlink signals DL) can lead to over ten times greater daily RFR absorption in a child's brain than a typical 10-minute mobile phone call (uplink exposure UL).

Using real-world 3G, 4G, and 5G measurements from Seoul and computer simulations of exposure rates into a six-year-old and an adult, researchers showed that while cell phone use creates short exposures of higher intensity, the constant low-level exposure from nearby cell towers can contribute far more to the child's total daily RFR dose over 24 hours.

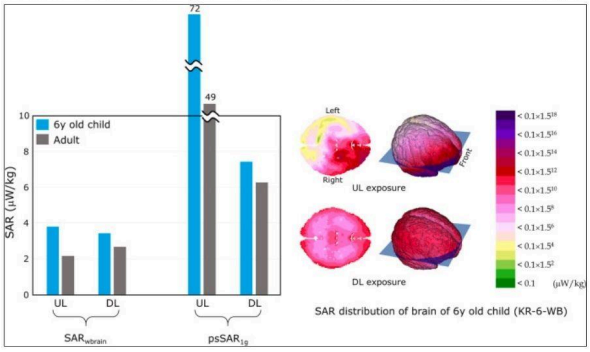

Figure 10 compares the specific absorption rate (SAR) in the brains of a child and an adult exposed to cell tower radiation (downlink DL) and cell phone radiation (uplink UL) and from real mobile networks in Seoul (2021), showing that the child's smaller head and thinner skull result in higher localized absorption of RF energy, indicating that younger brains take in more radiation under the same exposure conditions.

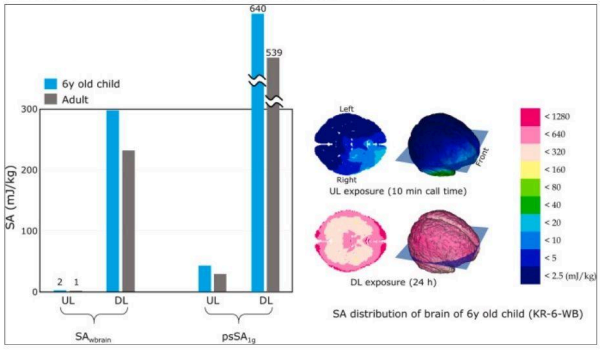

Figure 11 compares the daily whole-body specific absorption (SA) in a child and an adult exposed to real mobile network signals in Seoul (2021), showing more than a tenfold difference in total exposure between uplink (UL) cell phone radiation (DL) cell tower radiation.

Lee, AK. & Choi, HD. (2023)
Dosimetric assessment in the brain for downlink EMF exposure in Korean mobile communication networks.
Environmental Research, Volume 234, 116542

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While industry representatives often claim that radiation from cell towers is too "low" to cause adverse health effects, research shows that the cumulative exposure from nearby cell towers can exceed the radiofrequency (RFR) exposure children receive from typical cell phone use. In

a 2023 study published in *Environmental Research*, by Lee and Choi found that continuous 24-hour downlink signals from cell towers produced more than a ten-fold higher cumulative daily energy absorption in the brain compared to a child's exposure from mobile phone use.[24]

How the study was performed: The researchers measured real-world field strengths from 3G, 4G, and 5G base stations across Seoul, South Korea, to determine actual outdoor levels from cell towers and wireless base stations, including 4G/5G small cells and building-mounted antennas. They then conducted computer simulations using detailed anatomical models of an adult and a six-year-old child to calculate brain-specific absorption rates and cumulative energy absorption over time. The researchers selected a 10-minute daily mobile phone use period as a realistic time of cell phone uplink exposure for the child, based on previously published population data showing children averaged 10.7 minutes of voice calls per day over a ten-year period.

What did the study find?
Although a phone held next to the ear produces stronger short-term exposure, the continuous 24-hour downlink signals from cell towers resulted in more than ten times greater total daily RFR energy absorption in the brain than a 10-minute phone call.

"The energy in the brain from an UL signal from a mobile phone when assuming a 10-min call time per day showed a much lower contribution to the integrated cumulative energy (SA) of all EMFs in the mobile communication networks, in comparison to that from DL signals (24-h exposure). Thus, it was confirmed that DL exposure cannot be ignored in the exposure evaluation for the studies seeking the association between chronic brain diseases and EMF exposure related to mobile communication services."

Study Conclusion:
The authors conclude that because cell tower/base station RFR radiation is constant, its contribution to long-term cumulative exposure is substantial and "must be included in the comprehensive evaluation of the RF exposure."

Study on Kindergartens Finds Increased Exposure Inside and Outside Classrooms From Nearby Cell Towers and Cellular Base Stations

A 2016 study by Bhatt et. al. measuring RFR exposure in 20 Melbourne Australia kindergartens found that children attending schools within 300 meters of cell towers had nearly 3.5 times higher radiation exposure than those farther away.[2] The children's exposure was measured using RFR meters attached to their backpack and spot environmental readings were also performed inside and outside the kindergartens, capturing only ambient radiation from nearby sources. The researchers also found that most indoor RF radiation exposure to the children came from cell tower signals penetrating into the building, indicating that proximity to nearby towers is a primary driver of daily exposure for children in schools near cell towers.

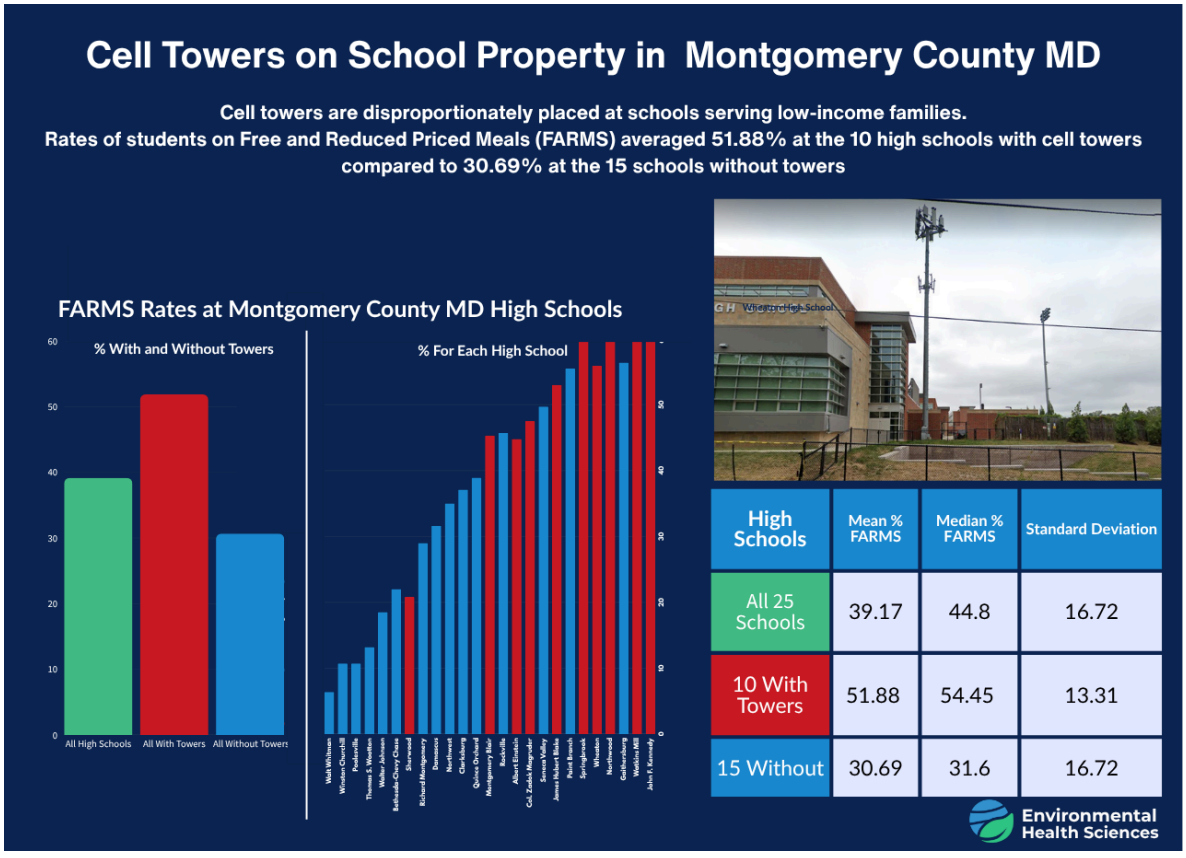
IV. Case Study: Montgomery County, MD

The author posed the question of whether cell towers in the U.S. are disproportionately located at schools that serve low-income families and considered Montgomery County, MD to perform an analysis.

The author performed an analysis of high schools with and without cell towers in Montgomery County, Maryland (MCPS) and Free and Reduced Priced Meals (FARM) rates to evaluate if there was disproportionate placement in schools with lower income families. The analysis was done using MCPS data on high schools and FARMS rates for the 2022-2023 school year, the latest available.

There are 11 schools with cell towers on their properties in Montgomery County. Ten are at high schools. One is at Daley elementary school. The analysis of Montgomery County Public Schools (MCPS) data for the 2022–2023 school year reveals an unequal distribution of cell towers across the county's 25 high school campuses. Schools serving larger populations of low-income students—measured by participation in the Free and Reduced-Price Meals (FARMS) program—are more likely to host cell towers on their property.

On average, the ten high schools with cell towers had a FARMS rate of 51.88%, while the fifteen schools without towers had a significantly lower average of 30.69%. This disparity suggests a pattern of inequity linked to socioeconomic status within the district.



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The above analysis was done using the latest MCPS data on high schools and FARMS rates for the 2022-2023 school year.

V. Cell Towers Increase Involuntary Exposures

- Cell tower antennas close to schools and homes increase continuous, full-body RFR exposures in the nearby areas.
- Numerous publications recommend a cell tower setback distance of at least 500 meters.[39,40,42,59–62]

A 2024 review entitled “Mobile Phone Infrastructure Regulation in Europe: Scientific Challenges and Human Rights Protection” published in Environmental Science and Policy, examined the growing body of evidence showing that the safety of mobile phone infrastructure cannot be considered guaranteed.[63] The authors framed the issue as a human rights concern, emphasizing governments’ duties to safeguard vulnerable populations like children from environmental pollution stating, “We conclude that, because scientific knowledge is incomplete, a precautionary approach is better suited to State obligations under international human rights law.”

Expert recommendations to distance homes and schools from cell towers

- The 2023 Santa Clara Medical Association Best Practices for Technology in Schools recommends reducing Wi-Fi exposure and restricting cell towers near schools.
- New Hampshire State Commission Report on 5G Health and Environment recommends a 1,500 foot setback for cell towers and 4G/5G antennas.
- The EPA School Siting Guidelines lists exposure to electromagnetic fields and the fall distance as "potential hazards" from cell towers. The EPA guidelines recommend schools "identify and evaluate cell towers within ~200 feet of prospective school locations."

Numerous research publications recommend a 1,500 foot setback for cell towers

- Pearce (2024) states “that deployment of base stations should be kept as efficient as possible to minimize exposure of the public to RFR and should not be located less than 500m from the population…”
- Rodrigues et al. (2021) concludes that to “avoid hazards to human health, the safest solution would be to switch off the RBS (radiobase station) in an area within a 500 m radius from residences, workplaces, hospital areas, kindergartens, and buildings.”
- Dode et al. (2011) found higher deaths from tumors within 500 meters from cellular base stations.
- Levitt & Lai (2010) state, “as a general guideline, cell base stations should not be located less than 1500 ft (*500 m) from the population, and at a height of about 150 ft (*50 m).”
- Khurana et al. (2010) found that eight of the 10 studies reported increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances less than 500 m from base stations.

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VI. The U.S. Permits High RFR Exposures Compared to Other Countries

The U.S. is among the countries that allow for the highest levels of cell tower radiofrequency radiation (RFR) in the environment.

The graph below shows the selected countries' regulations regarding public exposure limits for 1800 W/m2 equivalent plane wave density RFR, applicable to schools and/or homes. Many countries have limits that apply to places of "sensitive use" such as apartment buildings, schools, hospitals, permanent workplaces, and children's playgrounds. The U.S. has no specific safeguards for children or schools.

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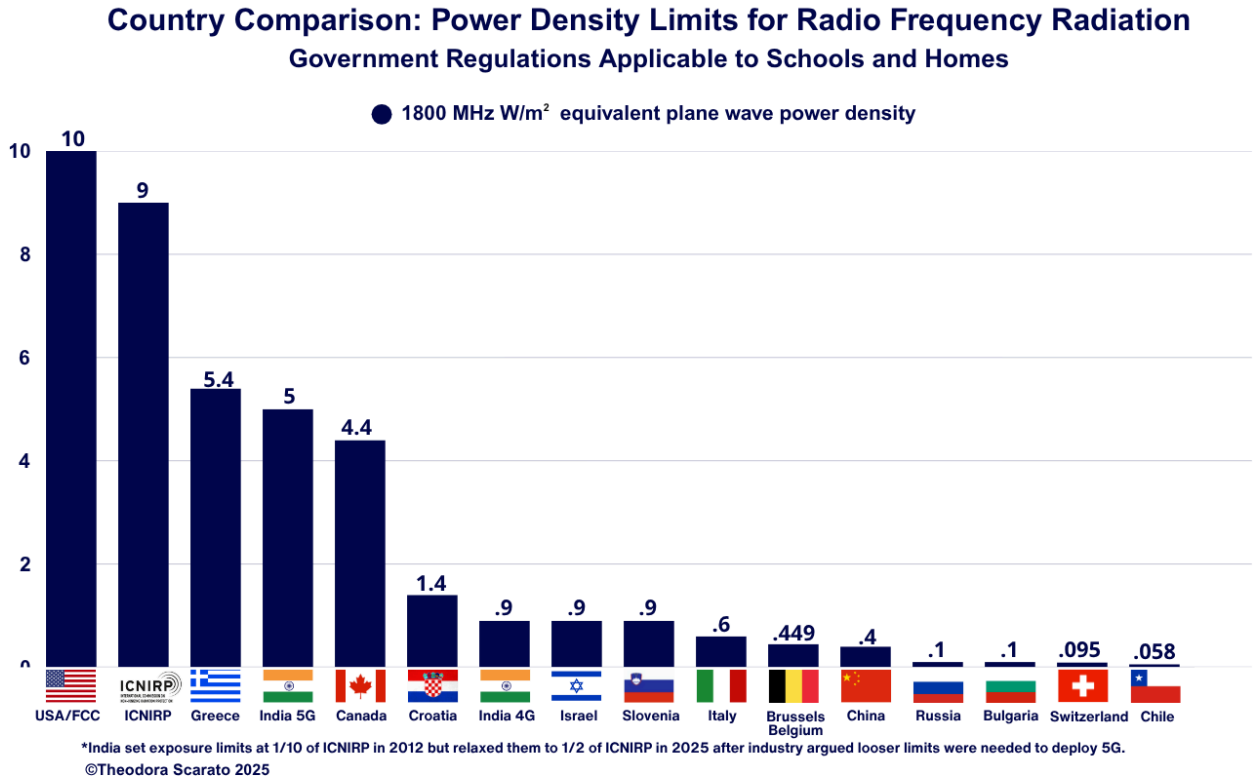

VII. U.S. Policy Lags Behind

- No federal health or scientific agency is currently conducting research on the health effects of everyday ambient RFR exposure.
- No oversight program to ensure tower emissions are compliant.
- No required yearly RFR emission checks or audits.
- No program to measure and monitor RFR exposures in communities.
- No premarket safety testing before deployment of new technologies.

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- No post-market surveillance of health or environmental impacts.
- No reporting mechanism for medical professionals to report impacts.
- No national, publicly accessible database of all cell tower and antenna sites.

No U.S. Federal Protections Despite Expert Calls

While some local communities have enacted safeguards distancing cell towers from schools, the U.S. lacks federal laws that address school cell towers. However, several expert groups, such as the New Hampshire Commission on 5G and the Santa Clara County Medical Association, recommend restricting cell towers at schools.[61,64,65]

U.S. School Districts that Ban New Cell Towers

- Los Angeles CA
- Palo Alto CA
- Temecula Valley CA
- West Linn-Wilsonville OR
- Portland OR, Loudoun County VA.

U.S. Communities with cell tower setback policies establish minimum distance requirements between wireless antennas and homes, schools, or other sensitive areas

- Shelburne MA (3,000 ft away from schools, 1,500 ft away from homes)
- Williamson County TN (1,500 ft schools)
- Copake NY (1,500 ft homes/schools)
- Sallisaw OK (1,500 ft homes)
- Walnut Creek CA (1,500 ft schools)
- Calabasas CA (1,000 ft homes/schools)
- Scarsdale NY (500 ft homes/schools)
- San Diego County CA (300 ft schools)
- Bedford NH (750 ft residential)
- Bar Harbor ME (1500 ft schools)

International Policies to Prohibit Cell Towers Near Schools

- **Russia:** Antennas for cell towers and base stations are no longer permitted near schools, with a national plan in place to relocate existing sites away from schools.
- **Greece:** Towers are banned on school grounds. Stricter RFR limits apply within a 300-meter radius around kindergartens, schools, hospitals, and elderly care facilities.
- **France:** Radiation levels must be minimized for towers or wireless facilities within 100 meters of schools, daycare centers, or healthcare establishments.
- **Turkey:** Cell antennas must be distanced from schools and playgrounds and not placed on the same floors as preschools or primary schools in multi-story buildings. RFR levels are continuously monitored near schools and hospitals.
- **Bangladesh**: Cell towers are prohibited on residential properties, schools, colleges, playing fields, densely populated areas, and heritage sites.
- **Israel**: Minimum setback of 100 meters for cell towers near schools and homes.

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- **Chile**: Cell antennas are not allowed in “sensitive areas” such as kindergartens, hospitals, and nursing homes.
- **Queensland, Australia**: New cell towers are prohibited on school property, with a 200 meter setback and emissions capped at no more than 1% of federal guidelines.
- **New Zealand**: Cell towers are prohibited on school property and a 50 meter setback from schools is required.
- **Toronto, Canada:** A "Prudent Avoidance Policy" recommends keeping RFR exposures at least 100 times below Health Canada’s guidelines.
- **India:** Cell towers are prohibited or removed near schools, colleges, orphanages and old age homes in Mumbai, Zilla Parishad, Rajasthan & Karnataka.

Conclusion:

U.S. federal oversight is nearly absent, and 1996 human exposure limits for RFR do not protect against long-term health effects. Thus, restricting cell towers on/near schools is primary prevention, a public health measure used internationally to reduce children’s RFR exposure and help mitigate health risk.

Recommendations include:

- Prohibit commercial towers on schools and daycare properties.
- Require buffer zones/setbacks to distance cell towers from homes, playgrounds, and schools.
- Update 1996 RFR exposure limits to address children’s vulnerability and long-term health effects via a robust, independent scientific evaluation.
- Require regular independent testing of RFR levels for schools and daycares, with information shared accessibly with the community.
- Reduce wireless exposure in classrooms by replacing Wi-Fi with hardwired Ethernet and enforcing cell phone off policies.
- Educate students, staff and families on how to reduce personal exposure.
- Create a national, publicly posted database of all cell towers and base station antenna installations along with measured RFR levels.

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