Bald Hill Pure and Clear Skies Association

PUBLIC COMMENT TO THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Response to the HHS Request for Information

Electromagnetic Fields (EMFs), Radiofrequency (RF) Radiation, and Wireless Radiation Exposure

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To the U.S. Department of Health and Human Services:

Bald Hill Pure and Clear Skies Association submits these comments advocating a precautionary, health-protective approach to electromagnetic fields (EMFs), radiofrequency (RF) radiation, and wireless radiation exposure. We urge HHS to put the protection of people and the environment at the center of its assessment, research priorities, and policy recommendations.

Our central concern is that protection from acute tissue heating is not an adequate substitute for examining chronic low-intensity exposure, non-thermal biological effects, cumulative exposure from multiple sources, and the needs of sensitive populations. Children, pregnant women, older adults, workers with elevated exposure, people with implanted medical devices, and people reporting electrosensitivity deserve specific attention.

We ask HHS to support biologically based exposure standards, independent research, real-world measurement, accessible health surveillance, and full disclosure of wireless infrastructure and device emissions. Communities need meaningful participation in siting decisions and practical access to wired alternatives and exposure-reduction measures. Environmental effects on wildlife, pollinators, plants, and livestock must also be addressed.

The following responses set out our requests under Questions 5 through 18 of the RFI, including subparts 5.n, 5.o, and 5.p. We ask HHS to apply the precautionary principle and take protective action while research continues, rather than placing the entire burden of establishing harm on the people exposed.

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Question 5 — Exposure standards and frameworks

What existing national and international exposure standards, guidelines, or regulatory frameworks should federal health agencies consider when evaluating the potential adverse health effects of human exposure to RF/EMF?

Our association's central concern is that the Federal Communications Commission's exposure limits, drawing on the Institute of Electrical and Electronics Engineers and the National Council on Radiation Protection and Measurements, rest on a thermal paradigm. We do not consider the prevention of acute tissue heating an adequate basis, by itself, for protecting the public from chronic RF/EMF exposure and non-thermal biological effects.

We therefore urge HHS to look beyond the familiar domestic framework and examine international standards, guidelines, and alternative frameworks that take non-thermal biological effects seriously.

Biologically based exposure standards

We ask HHS first to consider the body of international exposure guidelines developed by non-industry-affiliated scientists. The International Commission on Non-Ionizing Radiation Protection, or ICNIRP, is the body most often cited by the FCC and the World Health Organization, but its guidelines have been repeatedly criticized for conflicts of interest and for ignoring peer-reviewed research on oxidative stress, DNA damage, and reproductive harm at exposure levels far below its thresholds. The BioInitiative Report, compiled by an international group of scientists and public health experts, offers a fundamentally different approach. As Cindy Sage and her co-authors argue in BioInitiative A Rationale for a Biologically-based Exposure Standard, the basic restrictions should not be regarded as precisely determined values below which no adverse health effects can occur and above which clearly discernible effects will happen.

The BioInitiative framework proposes exposure limits orders of magnitude lower than ICNIRP's, grounded in the precautionary principle and in the actual peer-reviewed literature on biological effects. [1]

Independent recommendations and a moratorium

We also ask HHS to consider the growing body of scientific consensus documents calling for moratoriums and revised standards. In 2022, a team of researchers associated with the International Commission on the Biological Effects of EMF published a study concluding that regulatory agencies such as the Federal Communications Commission and the International Commission on Non-Ionizing Radiation Protection have systematically ignored health risks of radiation. As reported by NaturalNews.com and by ChildrensHealthDefense.org, both Lennart Hardell and Joel Moskowitz, associated with ICBE-EMF and its study, blamed regulatory agencies such as the Federal Communications Commission and the International Commission on Non-Ionizing Radiation Protection for failing to act on evidence of harm. The researchers called for a moratorium on further 5G deployment until independent, non-industry-funded studies can establish safety. Federal health agencies cannot credibly claim to be evaluating health effects while refusing to engage with this literature. [2, 3]

Risk-informed assessment and international comparison

We recommend a risk-informed approach to RF regulation that moves beyond a binary pass-fail thermal threshold toward a graded, probabilistic assessment of biological risk across exposure scenarios. A frequency-consequence framework should account for vulnerable populations, cumulative exposure, and non-thermal mechanisms without abandoning quantitative rigor.

We ask HHS to study why countries such as Switzerland, Italy, Russia, and China have adopted stricter RF limits and whether those limits correlate with better health outcomes.

We ask HHS to insist that international harmonization be transparent, include independent scientists without conflicts of interest, and apply the precautionary principle where evidence is uncertain.

Independence in international standard setting

We are also concerned about accusations that the WHO's International EMF Project has downplayed risks and relied on industry-funded studies. Because international standards often serve as the baseline for national regulations, independence and transparency must apply at the international level as well as within the United States.

Question 5.n — Scientific, technical, and regulatory changes

What scientific, technical, or regulatory changes by federal health agencies, if any, would improve the assessment, disclosure, and regulation of wireless radiation exposure?

Biological effects and chronic exposure

The first scientific change we request is a fundamental reorientation away from the thermal-only paradigm that has governed RF radiation safety standards since the 1990s. Current FCC limits are based exclusively on the thermal effects of acute exposure — essentially, whether tissue heats up enough to cause immediate harm. This framework ignores the vast body of peer-reviewed research demonstrating non-thermal biological effects at exposure levels far below current limits, including oxidative stress, DNA damage, blood-brain barrier disruption, and endocrine disruption. The assumption that if tissue does not heat, nothing happens, is scientifically indefensible, yet it remains the bedrock of federal policy. Federal health agencies should be required to adopt a biological-effects-based standard that accounts for chronic, cumulative exposure and vulnerable populations such as children, pregnant women, and the electrosensitive.

Independent research funding

We call for independent research funding and the elimination of conflicts of interest in RF/EMF safety assessment.

We ask HHS to support a public research fund financed by fees on wireless device manufacturers and telecommunications carriers, with funding decisions and research conducted independently of those industries. This fund should support independent, replicated studies by researchers with no financial

ties to the industry. We advocate prohibiting reliance on industry-funded research as the basis for public-health risk assessments.

Real-world measurement

On the technical side, we ask HHS to require comprehensive, real-world exposure assessment rather than the current practice of relying on computer modeling and limited spot measurements. The public deserves to know actual exposure levels in homes, schools, workplaces, and public spaces, measured with calibrated instruments and reported in a transparent, accessible format. This means mandatory RF monitoring networks in populated areas, mandatory disclosure of antenna locations and power levels, and mandatory labeling of all wireless devices with their maximum and typical exposure levels.

Accountable oversight

We are concerned that fragmented oversight allows responsibility for public-health protection to fall between agencies. The FCC, FDA, EPA, and NIH should not be able to defer the health question to one another while wireless infrastructure continues to expand. We ask HHS to advocate an independent, clearly accountable public-health body, free from industry influence, with authority to enforce meaningful penalties for violations. Regulatory decisions should be subject to public comment, transparent scientific review, and judicial oversight.

Disclosure and wired alternatives

We ask HHS to strengthen disclosure requirements substantially. Every wireless device sold in the United States should carry a prominent label disclosing its RF radiation emissions, comparable to the warnings on cigarette packages or pharmaceutical inserts. Cell towers and antennas should be required to post visible signage indicating their presence and power levels. Schools, hospitals, and public buildings should be required to disclose their wireless infrastructure and provide wired alternatives for those who wish to avoid exposure.

Local control and informed choice

We ask HHS to advocate restoration of meaningful local authority over wireless infrastructure siting. Communities should not be required to accept cell towers and small cells without meaningful input into decisions affecting their homes and neighborhoods. Federal preemption of local zoning decisions should be eliminated, and local decision-making should respect property rights, democratic self-governance, and health protection. Individuals should have the ability to opt out of wireless exposure in their homes and communities, and utilities should be required to provide wired alternatives for those who need them. Decisions should be made as close as possible to the individuals who bear the exposure.

Protection from involuntary exposure

We urge HHS to recognize the importance of protecting individuals and families from involuntary exposure. Public policy should protect the ability to refuse wireless smart meters, obtain wired internet and telephone service, create RF-free zones in homes and communities, and seek legal remedies for

harm from involuntary exposure. Participation in modern society should not require people to surrender meaningful choices about their exposure.

Reconsideration of existing exposure standards

The FCC has been accused of ignoring expert advice on EMF safety in maintaining its exposure standards in 2019. We ask HHS to bring an independent public-health perspective to reconsideration of those standards rather than treating an earlier regulatory decision as the end of the health inquiry.

Question 5.o — Research on exposure reduction and standards

Is additional research needed to develop, test, and evaluate the effectiveness of procedures and techniques for minimizing exposure to electronic product radiation? Where are the largest gaps, if any, in knowledge? What research is needed to appropriately evaluate current or future national and international exposure standards, guidelines, or regulatory frameworks?

Yes. We urge HHS to develop, test, and evaluate procedures and techniques for minimizing exposure to electronic product radiation. The need for this research is urgent.

In our view, the largest knowledge gaps concern biological mechanisms, cumulative exposure effects, and the adequacy of exposure standards based on thermal effects. Research should be designed to protect people under the conditions in which they actually live, not only to demonstrate compliance under controlled laboratory conditions.

Non-thermal biological mechanisms

The first and most glaring gap concerns the biological plausibility of non-thermal effects. Current national and international exposure standards, including those promulgated by the International Commission on Non-Ionizing Radiation Protection and the Federal Communications Commission, rest almost entirely on the assumption that the only harm from RF radiation is heating of tissue. This assumption is scientifically bankrupt. Independent research has repeatedly documented oxidative stress, calcium channel disruption, blood-brain barrier permeability, and DNA damage at exposure levels far below those that produce measurable heating. The research needed here is not more of the same industry-funded studies but independent, replicated, whole-organism studies using real-world exposure profiles rather than simulated single-frequency signals. The distinction matters because pulsed and modulated signals characteristic of 5G and Wi-Fi differ biologically from continuous wave exposures, a variable that most regulatory studies simply ignore.

Longitudinal studies of sensitive populations

A second major gap involves the absence of longitudinal epidemiological research on vulnerable populations. Children, pregnant women, the elderly, and the electrosensitive constitute populations whose exposure begins in utero and continues across a lifetime. Yet the major cohort studies that inform regulatory policy, such as those examining mobile phone use and brain cancer, typically rely on self-reported exposure data of dubious reliability and follow subjects for periods far too short to

capture latency periods that may span decades. The research needed is prospective, biomarker-based, and independent of telecommunications funding.

Evaluation of mitigation procedures

A third gap concerns the evaluation of actual mitigation procedures. While much attention is paid to exposure limits, remarkably little peer-reviewed research evaluates whether specific interventions, such as shielding materials, building design modifications, hardwired internet connections, or distance protocols, actually reduce biological harm.

Cumulative and combined exposure

A fourth gap is the near-total absence of research into cumulative and combined exposures. Real human beings are not exposed to a single frequency at a single power density; they are immersed in a complex soup of frequencies from cell towers, Wi-Fi routers, smart meters, cordless phones, and household appliances. Regulatory science typically assesses one source at a time, an approach that bears no relationship to lived reality. The research needed includes whole-body dosimetry in real environments, time-series analysis of multiple simultaneous exposures, and studies of synergistic effects between EMF and chemical toxicants.

Comparative evaluation of exposure standards

A fifth gap concerns the evaluation of international standards. Different countries have adopted wildly different exposure limits, with some nations setting thresholds hundreds or thousands of times stricter than those in the United States. The research needed is comparative and independent: why do these discrepancies exist, what biological assumptions underlie them, and which standards actually protect health?

Nutritional and lifestyle research

We also request research on non-technological mitigation, including nutritional and lifestyle interventions. If EMF exposure operates partly through oxidative stress and inflammatory pathways, antioxidant-rich diets, melatonin support, grounding practices, and other natural interventions warrant investigation for their potential protective role.

We ask HHS to support randomized controlled trials of nutritional and natural-medicine protocols, together with observational studies of populations with low EMF exposure and strong natural-health practices.

Research independence and funding

We request meta-research examining who funds EMF studies, how conflicts of interest shape conclusions, and whether regulatory processes suppress or marginalize findings that conflict with industry interests.

We support decentralized funding models, citizen-initiated research, and transparent data sharing as essential parts of this research agenda.

Practical exposure-reduction measures

We ask HHS to evaluate and communicate practical ways to reduce exposure, including hardwired internet connections instead of Wi-Fi, keeping cellphones away from the body, turning off wireless devices when they are not needed at night, and creating sleeping environments with minimal EMF exposure.

Our association supports an exposure-reduction strategy that includes distance, shielding, and wired connections wherever practical.

Question 5.p — Exposure-related classification characteristics

How, if at all, should a classification system account for exposure-related characteristics, including operating frequency, power density, specific absorption rate (SAR), electric- and magnetic-field strength, modulation and pulse characteristics, duty cycle, beamforming, simultaneous exposure to multiple frequencies, duration of exposure, distance from the source, proximity to the body, and cumulative exposure over time?

We believe an exposure classification system must account for the physical variables that determine biological interaction, rather than reducing exposure to one averaged number. Operating frequency determines how deeply energy penetrates tissue and which structures absorb it. Power density describes energy crossing a surface, while specific absorption rate (SAR) describes the rate of RF energy absorption per unit mass of tissue. Electric- and magnetic-field strength characterize the near-field environment. Modulation and pulse characteristics distinguish continuous, intermittent, and pulsed signals; duty cycle describes the fraction of time a device transmits; and beamforming concentrates energy into steerable beams. Simultaneous exposure to multiple frequencies, exposure duration, distance from the source, proximity to the body, and cumulative exposure over time must all be central to the classification. Our concern is that a system centered on thermal thresholds and averaged power density does not adequately address this combination of factors or the potential for non-thermal effects.

Public access to operating characteristics

Cindy Sage, from BioInitiative A Rationale for a Biologically-based Exposure Standard, argues that disclosure of the location and operating characteristics of all wireless antenna sites should be provided to the public in an easily accessible fashion so that informed choices can be made. [1]

Frequency-specific classification

We ask HHS to require frequency-specific classification. A 50 Hz power-line field and a 28 GHz millimeter-wave signal are both electromagnetic phenomena, but they interact with the body differently. Low-frequency fields induce currents in tissue and can affect voltage-gated ion channels and cellular signaling, while higher frequencies deposit energy closer to the skin surface. A generic EMF label should not conceal these differences. Classification must preserve the distinctions among frequencies and exposure mechanisms.

Power density and specific absorption rate

Power density and SAR deserve separate scrutiny because they are the metrics most often used to declare exposures safe. Power density is measured in microwatts or milliwatts per square centimeter and is typically averaged over time. SAR is measured in watts per kilogram and is used to certify that devices do not heat tissue beyond a threshold. Both metrics are thermal in orientation. They assume that if tissue does not heat, nothing happens. That assumption is contradicted by research documenting non-thermal biological effects, including oxidative stress, calcium flux changes, and alterations in melatonin production. A classification system built on thermal metrics alone will systematically undercount risk, because it asks the wrong question. The right question is not whether exposure heats tissue, but what the exposure does to living systems at the levels people actually experience.

Modulation, pulses, duty cycle, and beamforming

Modulation and pulse characteristics are routinely ignored in regulatory frameworks, yet they may be among the most biologically significant variables. A continuous wave and a pulsed signal of identical average power can produce very different effects, because pulsed signals deliver energy in sharp bursts that may disrupt biological rhythms and cellular processes in ways continuous exposure does not. Similarly, duty cycle matters enormously. A device that transmits one percent of the time is not equivalent to one that transmits continuously, even if peak power is the same. Beamforming compounds this problem by concentrating radiation into directional beams that can be aimed at specific locations, including occupied spaces. A classification system that does not record modulation type, pulse repetition rate, duty cycle, and beam-steering behavior is not classifying exposure; it is classifying averages.

Simultaneous exposure to multiple frequencies

Simultaneous exposure to multiple frequencies is perhaps the most glaring omission in current practice. Real environments are not single-frequency laboratories. A person in a modern home may be exposed to Wi-Fi at 2.4 and 5 GHz, cellular signals across multiple bands, Bluetooth, smart meters, cordless phones, and household wiring fields, all at once. Testing each source in isolation and then declaring the combination safe is an unsupported extrapolation. Combined exposures can produce additive or synergistic effects that no single-source test can detect. A credible classification system must therefore define rules for multiple simultaneous sources, not merely for one device at a time.

Duration, distance, and proximity to the body

Duration, distance, and proximity to the body are the variables that translate device specifications into actual human dose. A router across the room and a smartphone held against the head are not comparable exposures even if they emit at the same frequency and power. Distance matters because field strength falls off with distance, and proximity matters because near-field coupling with the body can be far more intense than far-field calculations suggest. Duration matters because cumulative exposure over years is not equivalent to a momentary measurement. A classification system that certifies a device based on a snapshot measurement at a fixed distance, while ignoring how people

actually use it, is certifying a laboratory artifact rather than a real-world condition. Cumulative exposure over time must be integrated into any standard that claims to protect health.

Required classification information

We recommend that the classification record, at minimum, frequency band and modulation type; peak and average power density; SAR where applicable, with its thermal limitations made explicit; electric- and magnetic-field strength in the near field; duty cycle and pulse characteristics; beamforming behavior and steering range; simultaneous multi-frequency exposure; and cumulative exposure based on realistic duration, distance, and body proximity. These data should be public and searchable. The system should recognize non-thermal effects, require manufacturers to demonstrate safety rather than presume it, and be revised as evidence accumulates.

Question 6 — Evidence concerning current exposure limits

What scientific evidence exists about potential adverse health effects caused by current exposure limits?

The scientific literature reports cancer, DNA damage, neurological, developmental, metabolic and sleep-related findings following certain RF exposures. Such findings warrant a more protective examination of whether current U.S. limits adequately address long-term and repeated exposure, including effects beyond acute tissue heating. The studies below are especially relevant.

- **National Toxicology Program (2018), lifetime rodent studies —** The U.S. NTP found clear evidence of malignant heart schwannomas in exposed male rats and some evidence of brain and adrenal tumors. These are consequential hazard findings from controlled animal experiments; rat whole-body SARs of 1.5–6 W/kg were above the current U.S. general-public whole-body SAR limit.
  Source: https://ntp.niehs.nih.gov/research/topics/cellphones
- **Falcioni et al. (2018), Ramazzini Institute lifetime base-station model —** In 2,448 rats exposed from prenatal life to natural death to a 1.8 GHz GSM far-field signal, investigators observed a statistically significant increase in heart schwannomas among males at the highest exposure of 50 V/m. This model directly examined long-duration, base-station-like radiation.
  Source: https://pubmed.ncbi.nlm.nih.gov/29530389/
- **Lerchl et al. (2015), tumor promotion —** RF-exposed, carcinogen-treated mice developed increased numbers of lung and liver tumors and lymphomas. The tested whole-body SAR range included 0.04 W/kg, numerically below the FCC general-public whole-body benchmark of 0.08 W/kg.
  Source: https://pubmed.ncbi.nlm.nih.gov/25749340/
- **Smith-Roe et al. (2020), DNA damage in NTP animals —** Using the comet assay, investigators reported significantly increased DNA damage in selected brain and blood-cell samples from RF-exposed rats and mice. The study addresses genetic injury mechanisms relevant to risk assessment.
  Source: https://pubmed.ncbi.nlm.nih.gov/31633839/

- **Panagopoulos (2019), chromosome damage in cultured human cells —** An in-vitro investigation reported increased chromatid gaps and breaks in human lymphocytes exposed to 3G mobile-phone emissions. These findings support examining genotoxic endpoints beyond temperature elevation.
  Source: https://pubmed.ncbi.nlm.nih.gov/31516130/
- **Broom et al. (2019), early-life LTE exposure —** Mice exposed to pulsed LTE signals during prenatal and early development showed persistent alterations in adult activity and behavior. Whole-body SARs of 0.5 or 1 W/kg were above the general-public whole-body benchmark, but the developmental findings are pertinent to how limits are evaluated.
  Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC6790696/
- **Abdel-Rassoul et al. (2007), health near base stations —** In a comparison of 85 nearby residents and 80 controls, sleep disturbance was reported by 23.5% versus 10%, together with other neurobehavioral complaints. The study directly addresses community experiences around telecommunications infrastructure.
  Source: https://pubmed.ncbi.nlm.nih.gov/16962663/
- **Gómez-Perretta et al. (2013), measured bedroom exposure and sleep —** In a cross-sectional reanalysis of 88 participants, measured GSM exposure was associated with trouble sleeping (odds ratio 1.49, 95% confidence interval 1.20–1.84 per unit increase in log exposure). Chronic sleep outcomes deserve explicit review when assessing public protection.
  Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC3885815/
- **Avendaño et al. (2012), human sperm laboratory experiment —** Human semen samples positioned near a Wi-Fi-connected laptop exhibited reduced sperm motility and increased DNA fragmentation. This supports further examination of reproductive endpoints in RF safety assessments.
  Source: https://pubmed.ncbi.nlm.nih.gov/22112647/
- **Masoumi et al. (2018), pancreatic and metabolic effects —** Rats exposed to 2.45 GHz Wi-Fi radiation showed impaired insulin secretion and increased pancreatic oxidative-stress markers. The results extend the health questions to metabolic processes.
  Source: https://pubmed.ncbi.nlm.nih.gov/29913098/
- **IARC (2011), RF carcinogenic-hazard evaluation —** The International Agency for Research on Cancer classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B). That classification supports continued cancer-focused examination of RF exposures and existing protection standards.
  Source: https://www.iarc.who.int/pressrelease/iarc-classifies-radiofrequency-electromagnetic-fields-as-possibly-carcinogenic-to-humans/

- **Requested action:** HHS should commission an independent, publicly documented reassessment of current RF limits covering cancer, sleep, neurological development, reproductive function and metabolic health; require long-term research on repeated exposure; and recommend federal legislation allowing counties to consider credible health evidence when deciding where wireless facilities are installed. Current 47 U.S.C. § 332(c)(7)(B)(iv) restricts health-based local siting decisions for covered

facilities compliant with FCC RF rules.

Legal reference: https://www.law.cornell.edu/uscode/text/47/332

Question 7 — Methods for characterizing RF exposure

What scientific methods are currently available for accurately characterizing individual and population-level RF radiation exposure?

We recommend that HHS combine population-level methods, including environmental surveys and modeling, with individual-level methods that measure exposure through personal monitoring. Each approach has distinct advantages and limitations, and the choice of methods should reflect the research question, population, and resources available. Public-health protection requires an assessment of actual exposure, not simply certification of individual devices.

Environmental surveys

Population-level exposure assessment typically begins with environmental surveys that measure RF field strengths in specific locations, such as near cell towers, broadcast antennas, or Wi-Fi access points. These surveys employ broadband meters and spectrum analyzers to quantify power density across relevant frequency bands.

Environmental surveys capture only a snapshot of ambient fields and cannot account for the highly variable and cumulative exposures individuals experience as they move through different environments. Consequently, population-level estimates derived from such surveys are inherently coarse and may systematically underestimate true exposure, particularly in indoor environments where building materials and reflective surfaces create complex field patterns.

Geospatial modeling

To address the limitations of fixed-site measurements, researchers have developed geospatial modeling techniques that combine data from multiple sources, including antenna databases, terrain maps, and building inventories, to predict RF exposure across large areas. These models can incorporate variables such as distance from transmitters, antenna height, frequency, and transmission power to generate exposure maps. While useful for epidemiological studies, geospatial models rely on assumptions about propagation that may not hold in real-world conditions. For instance, the presence of trees, buildings, and other obstacles can attenuate or reflect signals in ways that are difficult to predict. Moreover, these models often omit important sources of exposure, such as personal wireless devices and household appliances, leading to incomplete exposure profiles. The resulting misclassification can bias epidemiological findings, either masking true associations or creating spurious ones.

Personal exposure monitoring

Individual-level exposure assessment, by contrast, seeks to capture the actual RF fields to which a person is exposed throughout their daily activities. The most common tool for this purpose is the personal exposure meter, a portable device that continuously records RF field strength across multiple

frequency bands. These meters are typically worn on the body, often on an armband or belt, and log data at frequent intervals. They can distinguish between uplink and downlink transmissions, providing insight into whether exposure comes from a person's own mobile phone or from environmental sources. However, personal exposure meters have significant limitations. Their accuracy can be affected by body shielding, which occurs when the human body absorbs or reflects RF signals, leading to measurements that do not reflect the true incident field. Additionally, the calibration of these devices is challenging, and inter-device variability can be substantial.

Device-based exposure estimates

Another approach to individual exposure assessment involves the use of smartphone applications that estimate RF exposure based on the device's own transmission power and network conditions. While convenient and cost-effective, these apps provide only a rough approximation. They do not measure ambient fields from other sources and are highly dependent on the phone's hardware and software. Furthermore, they cannot account for the spatial distribution of fields within the body, which is critical for understanding potential tissue-specific effects. The limitations of such methods highlight a broader problem: the lack of standardized, validated protocols for RF exposure assessment. Without such protocols, comparisons across studies are difficult, and meta-analyses are compromised.

Controlled laboratory exposure

In laboratory settings, researchers can characterize RF exposure with much greater precision using controlled exposure systems. These systems, such as transverse electromagnetic (TEM) cells and reverberation chambers, allow precise control over frequency, polarization, and field strength. They are essential for mechanistic studies investigating biological effects at the cellular and molecular levels. However, laboratory findings cannot be directly extrapolated to real-world exposure scenarios, where fields are highly variable and include multiple frequencies simultaneously. The gap between laboratory and field exposure is a major challenge in RF research, and it underscores the need for improved dosimetry that bridges these contexts.

Dosimetry and anatomical models

Dosimetry, the science of quantifying the amount of RF energy absorbed by biological tissue, is a critical component of exposure assessment. The specific absorption rate (SAR) is the standard metric for RF dosimetry, representing the rate at which energy is absorbed per unit mass of tissue. SAR can be measured experimentally using phantoms that simulate human tissue properties, or estimated computationally using numerical models of the human body. These models, based on magnetic resonance imaging (MRI) scans, can calculate SAR for various exposure scenarios with high spatial resolution. However, SAR is frequency-dependent and varies greatly across different tissues and body sizes. Children, for example, have thinner skulls and higher tissue conductivity, which can lead to higher SAR values than in adults for the same external field. This variability complicates the derivation of safety limits and highlights the need for age-specific dosimetry.

Emerging measurement tools

Emerging technologies promise to improve RF exposure assessment. One promising avenue is the use of wearable sensors that incorporate multiple types of detectors, including electric and magnetic field sensors, to provide a more comprehensive picture of exposure. However those wearable sensors use the same wireless protocols that can be harmful. Another is the development of advanced computational methods, such as machine learning algorithms, that can integrate data from diverse sources to predict exposure more accurately. However, these technologies are still in early stages, and their validation requires rigorous testing against gold-standard methods.

Variability and uncertainty

A fundamental challenge in RF exposure assessment is the inherent variability of exposure. Unlike exposure to a stable chemical agent, RF exposure fluctuates rapidly in time and space, depending on the person's location, the devices they use, and the surrounding infrastructure. This variability means that a single measurement or even a short-term monitoring period may not represent long-term average exposure. To capture this variability, researchers use statistical methods to characterize exposure distributions and to estimate uncertainties. These methods include Monte Carlo simulations, which model the range of possible exposures based on input distributions, and probabilistic risk assessment, which quantifies the likelihood of exceeding specific exposure thresholds. Such approaches are essential for understanding the range of exposures in a population and for identifying susceptible subgroups.

Question 8 — Improving real-world exposure assessment

What, if any, improvements in exposure assessment methodologies are needed to better evaluate real-world exposure conditions?

We urge HHS to improve exposure assessment so that it reflects a person sleeping beside a smart meter, working beneath a cell tower, or carrying a transmitting phone against the body for hours each day. Averaged, laboratory-idealized conditions should not substitute for these real-world situations.

Longitudinal and adaptive monitoring

Wireless infrastructure is not stationary. New frequency bands, denser small-cell deployment, beamforming antennas, and rising device density mean that the exposure profile of a given neighborhood changes materially over time. Any methodology that treats a one-time survey as a permanent characterization of exposure will inevitably underestimate cumulative burden. Exposure assessment must therefore become longitudinal and adaptive, tracking changes in the ambient field rather than freezing a snapshot and calling it science.

Multivariate assessment

We ask HHS to move exposure assessment from single-variable measurement toward multivariate analysis of interacting factors.

Real-world EMF exposure is inherently multivariate: frequency, modulation, duration, peak intensity, concurrent chemical exposures, and individual susceptibility all interact. Isolating one variable in a laboratory chamber and declaring it safe tells us almost nothing about the person in an apartment building saturated with Wi-Fi, cellular, and smart-meter signals.

Peak events and time averages

We recommend explicit attention to peak events rather than exclusive reliance on long-term averages.

A person's exposure is not a gentle average but a series of abrupt, high-intensity events: a phone connecting to a tower, a microwave oven operating, a smart meter transmitting. Averaging these spikes into a daily mean conceals the biological insult. Assessment protocols that privilege the average over the peak are structurally biased toward finding no effect.

Objective measurement of actual exposure

We recommend real-time observation of actual behavior and exposure rather than reliance on recall and questionnaires alone.

Self-reported exposure is unreliable; people cannot accurately recall how many minutes they held a phone to the ear or how close they stood to a router. Objective, computer-based real-time measurement closes this gap and yields data that reflect what actually happened, not what a subject believes happened. Those computer based measurement should not participate to the emission of the same radiations that are intended to measure – so they should not rely on Wi-Fi, bluetooth and other wireless protocols but only on wired technology with adequate shielding.

Independence and practical guidance

We ask HHS to ensure that exposure assessment is independent of the entities being assessed.

Genuine reform demands decentralized, transparent, and independently funded measurement programs, with raw data open to public scrutiny.

We also ask HHS to connect measurement with practical exposure-reduction guidance. A methodology that measures exposure but never helps people reduce it is incomplete.

Question 9 — Technical and exposure-related disclosure

What, if any, technical and exposure-related information should be disclosed to consumers, residents, workers, schools, healthcare providers, and local governments?

We ask HHS to require disclosure of the basic physical identity of an exposure: frequency or frequency band, modulation characteristics, duty cycle, peak and average power densities, antenna gain and beam patterns, and distance from the source to occupied spaces. These parameters should be accessible to the people affected, not withheld as trade secrets. They are central to understanding exposure and evaluating compliance.

A resident who cannot obtain the frequency, power, and distance data for a nearby cell tower or smart meter cannot make an informed decision about where to sleep, where to place a child's bed, or whether to object to a proposed installation.

Cumulative and temporal exposure

Second, disclosure must extend to the cumulative and temporal dimension of exposure. A single device may be trivial in isolation, but the modern environment is saturated with overlapping sources: Wi-Fi routers, cell towers, smart meters, cordless phones, baby monitors, and the ever-growing array of internet-of-things devices. The relevant question is not whether one source complies with a limit but what the total body burden looks like over days, months, and years.

If the industry and its regulators wish to claim safety, they must disclose the cumulative exposure data that would allow independent researchers to assess it. Otherwise, the public is asked to accept an assurance that cannot be tested.

Workers and their representatives

We advocate full technical disclosure to workers and their representatives. Workers in telecommunications, utilities, healthcare, and education need information about the equipment and exposure conditions they encounter, particularly where occupational exposure may be elevated.

Employers should be required to provide real-time or near-real-time exposure monitoring, to disclose the results to workers and their unions, and to make the data available to occupational health providers.

Schools and healthcare settings

Fourth, schools and healthcare providers occupy a special position because they serve populations that are uniquely vulnerable: children, the elderly, the immunocompromised, and the injured. A school that installs a powerful Wi-Fi system or permits a cell tower on its grounds is making a decision that affects children who cannot consent. A hospital that deploys wireless monitoring and communication systems is making a decision that affects patients whose physiological state may make them more susceptible to electromagnetic interference and biological effects. These institutions should be required to disclose the technical specifications of their systems, the measured exposure levels in classrooms and patient rooms, and any documented incidents of electromagnetic interference with medical devices. Parents and patients have a right to know what they are sending their children and themselves into.

Local governments

We ask HHS to support access by local governments to the technical information necessary for land-use and public-health decisions. Federal preemption and unresolved scientific questions should not become reasons to withhold information from affected communities. Local governments should have independent technical assessments, including RF surveys, before approving new installations, and those assessments should be public.

Communication of uncertainty

We ask HHS to require honest communication of uncertainty.

This is the standard that should govern RF disclosure: not a false assurance of safety, but a candid statement of what is known, what is not known, and what level of effect can be excluded. The public is capable of understanding uncertainty; what it cannot tolerate is being misled.

Accountability and remedies

We call for enforceable accountability alongside disclosure. If exposure exceeds disclosed limits, or monitoring data are falsified or withheld, meaningful penalties should follow.

In the case of RF exposure, that means real-time monitoring at the point of exposure, not industry-sponsored averages. It means independent testing, not self-certification. And it means the right of citizens to sue when disclosure is denied or falsified.

Question 10 — Data sources and health surveillance

What data sources or surveillance systems currently exist to monitor potential adverse health effects associated with RF radiation exposure? Should additional data sources or surveillance systems be developed? Please discuss the benefits and challenges of the following data sources and surveillance systems, as relevant: a. disease registries. b. occupational monitoring. c. environmental monitoring. d. longitudinal cohort studies. e. biomonitoring. f. adverse event reporting. g. disease or illness clusters.

We ask HHS to build an independent, transparent surveillance system that combines exposure measurement with health-outcome data. Existing approaches offer useful starting points, but each has limitations. We recommend the following actions for each of the RFI's surveillance categories.

10.a — Disease registries

Disease registries, such as cancer registries maintained by government agencies, offer a potential tool for tracking health outcomes that may be linked to RF exposure. However, their utility is severely constrained by several factors. First, these registries typically do not record RF exposure data, making it impossible to establish causal links. Second, the latency period for many cancers and chronic diseases can be decades, during which exposure patterns change dramatically.

We ask HHS to strengthen disease registries through independent auditing and the integration of RF exposure histories.

10.b — Occupational monitoring

Occupational monitoring provides a more direct means of assessing RF exposure in workers who handle or are near high-power RF equipment, such as telecommunications technicians, radar operators, and medical staff using MRI or diathermy devices. This approach has the advantage of documented exposure levels and the ability to correlate with health outcomes through medical surveillance. However, it is limited to a small subset of the population and often suffers from underreporting of

adverse effects due to fear of job loss or employer retaliation. Moreover, the exposure limits used in occupational settings are based on thermal effects only, ignoring non-thermal biological effects that a growing body of independent research has identified.

We ask HHS to expand occupational monitoring and make the results transparent, with workers able to report health concerns without retribution.

10.c — Environmental monitoring

Environmental monitoring of RF radiation levels is perhaps the most decentralized and citizen-accessible data source. Community-led monitoring initiatives, using affordable RF meters, have revealed that actual exposure levels in homes, schools, and public spaces often exceed what industry and government reports claim.

Environmental monitoring faces challenges: it requires standardized protocols, calibration of instruments, and interpretation of complex signals.

We request funding and support for independent environmental monitoring, including community-led initiatives.

10.d — Longitudinal cohort studies

Longitudinal cohort studies, including COSMOS in Europe, follow large groups over time to investigate associations between RF exposure and health outcomes. Such studies can provide important epidemiological evidence, but they are expensive and slow, and exposure assessment is a central challenge. Reliance on self-reported cellphone use can undermine the accuracy of the exposure record.

We ask HHS to support longitudinal studies independent of telecommunications and pharmaceutical interests and to incorporate objective exposure metrics such as body-worn dosimeters.

10.e — Biomonitoring

Biomonitoring, which involves measuring biomarkers of exposure or effect in human tissues, offers a more direct window into biological perturbations caused by RF radiation. For instance, studies have shown increased oxidative stress markers, DNA damage, and changes in melatonin levels after RF exposure.

However, biomonitoring for RF is still in its infancy. Challenges include the lack of validated biomarkers specific to non-thermal RF effects, the difficulty of distinguishing RF effects from other environmental stressors, and the ethical and logistical hurdles of collecting biological samples. Despite these challenges, biomonitoring is essential for early detection of harm, and it should be developed with a focus on non-invasive, repeated measures in vulnerable populations such as children and pregnant women.

10.f — Adverse-event reporting

Existing post-market reporting approaches, including the FDA's MedWatch and the Vaccine Adverse Event Reporting System, provide models for collecting health complaints after products are in use. We ask HHS to establish a comparable, mandatory RF-focused reporting system and a centralized database of health complaints associated with RF-emitting devices and exposure environments.

This reporting system should be independent, accessible to the public, and protected from industry pressure.

10.g — Disease or illness clusters

Disease or illness clusters, such as cancer clusters near cell towers or Wi-Fi hotspots, are often the first signal of an environmental health hazard. These clusters are typically identified by vigilant citizens and local healthcare providers, not by government agencies. For example, clusters of brain tumors and rare cancers have been reported near cell towers in several countries.

We ask HHS to support independent epidemiological investigations of reported RF-related clusters that account for exposure timing, duration, and intensity.

The challenge is that cluster investigations are resource-intensive and often met with hostility from industry and government.

10.h — Other: a citizen-driven monitoring network

We propose a nationwide, citizen-driven RF monitoring network that collects real-time exposure data and connects those data to health outcomes through privacy-preserving records, including investigation of blockchain-secured recordkeeping. We also request mandatory adverse-event reporting for RF-emitting devices, penalties for suppression of reports, and independent cohort studies free from telecommunications and pharmaceutical funding. Decentralization, transparency, and independent funding should guide this effort.

Question 11 — Sensitive populations

Should exposure assessment or risk evaluation differ for sensitive populations such as those noted below? Please explain.

Yes. We ask HHS to assess sensitive populations separately rather than presume that an average adult exposure model protects everyone. These populations include children, pregnant women, older adults, people with implanted medical devices, workers with elevated occupational exposure, people with preexisting conditions such as arrhythmias or autoimmune disorders, and people reporting electromagnetic hypersensitivity.

Beyond an average-adult model

The foundational flaw in current risk evaluation lies in its reliance on average adult male physiology as the baseline. This is not a neutral scientific choice; it is a political one that privileges industrial

convenience over human health. Children have thinner skulls, higher water content in tissues, and developing nervous systems that are far more susceptible to radiofrequency radiation.

When the Federal Communications Commission and other agencies set exposure limits, they lean on thermal effects models that ignore non-thermal biological responses altogether. The result is a regulatory framework that is structurally incapable of protecting sensitive populations because it does not even acknowledge their existence as distinct risk groups. This is not an oversight; it is a feature of a system captured by telecommunications interests.

Individualized assessment and biomarkers

We ask HHS to move beyond comparing an ambient field-strength measurement with a threshold derived from healthy adults. Exposure assessment for sensitive populations should include investigation of biomarkers that reflect actual biological impact.

For sensitive populations, the biomarker approach is essential. Measuring oxidative stress markers, inflammatory cytokines, or heart rate variability in response to EMF exposure provides a far more accurate picture of risk than any generic field strength measurement. This is especially true for individuals with electromagnetic hypersensitivity, whose symptoms are often dismissed by mainstream medicine precisely because the standard assessment tools are not designed to detect them.

Precaution and distinct exposure profiles

Risk evaluation for these groups should not wait for definitive epidemiological evidence, which may take decades to accumulate. It should proceed on the basis of biological plausibility and mechanistic evidence, both of which strongly suggest that non-thermal EMF effects are real and harmful to susceptible individuals.

Workers in certain occupations, children in schools with Wi-Fi, and residents near cell towers are all subgroups with distinct exposure profiles and distinct vulnerabilities.

Safety margins for sensitive populations

The human body is not a uniform resistor; it is a complex electrochemical system with individual variations in conductivity, resonance, and repair capacity. For a person with a pacemaker, a pregnant woman, or a child with autism, the same field strength that is negligible for a healthy adult male may be profoundly disruptive. Risk evaluation must therefore incorporate safety factors that are orders of magnitude greater for sensitive populations, not merely a tenfold uncertainty factor that is applied universally.

We recommend real-time, individualized monitoring for vulnerable groups in schools, hospitals, and residential areas. Risk evaluation should address non-thermal mechanisms and include a margin of safety that protects the most sensitive individuals, not only the average. We advocate placing the burden on industry to demonstrate safety for all subpopulations before deployment rather than asking affected individuals to establish harm afterward.

Question 12 — Evidence below current federal exposure limits

What scientific evidence exists regarding potential adverse health effects associated with RF radiation exposure at levels below current federal exposure limits?

We ask HHS to give full consideration to evidence of potential adverse health effects at RF exposure levels below current federal limits. Our concern is that the FCC's limits, adopted in 1996 around thermal effects, do not adequately address non-thermal interactions such as oxidative stress, calcium flux changes, blood-brain barrier permeability, or DNA strand breaks. Compliance with a thermal threshold should not end the inquiry into biological effects.

Several experimental and observational studies report biological changes or concerning health associations where measured incident RF field strengths, power densities or whole-body SARs are below a corresponding numerical FCC public-exposure reference value. We ask HHS to review these findings directly rather than assuming that non-ionizing radiation is harmless. These are comparisons to specified benchmarks, not a claim that every experiment independently establishes compliance with every applicable dosimetric requirement.

Comparison benchmarks: FCC general-public whole-body SAR 0.08 W/kg; far-field power-density MPE approximately 0.617 mW/cm² at 925 MHz and 1.0 mW/cm² at 1.8–2.45 GHz (subject to applicable measurement and averaging rules).
https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-1/subpart-I/section-1.1310

- **Lerchl et al. (2015), low-SAR tumor-promotion experiment —** Tumor-promoting effects were reported in carcinogen-treated mice across experimental RF exposures including 0.04 W/kg whole-body SAR, half the numerical FCC general-public whole-body SAR limit. This finding is directly relevant to the adequacy of protective thresholds.
  Source: https://pubmed.ncbi.nlm.nih.gov/25749340/
- **Meo et al. (2015), glycated hemoglobin in schoolchildren —** At 925 MHz, investigators measured 9.601 versus 1.909 nW/cm² at two schools, both far below the U.S. public MPE (~617,000 nW/cm²). The higher-exposure group had a higher mean HbA1c (5.44% versus 5.32%; p=0.007).
  Source: https://pubmed.ncbi.nlm.nih.gov/26580639/
- **Meo et al. (2018 online/2019 print), student cognitive performance —** Two schools had measured levels of 2.010 and 10.021 µW/cm² at 925 MHz, below the public MPE (~617 µW/cm²). The higher-exposure group scored worse on selected motor and spatial-working-memory measures.
  Source: https://pubmed.ncbi.nlm.nih.gov/30526242/
- **Abdel-Rassoul et al. (2007), sleep disturbance near base stations —** Sleep disturbance occurred in 23.5% of nearby residents versus 10% of controls. Reported field power densities were approximately 0.002–0.0067 mW/cm², below public MPE values applicable to the cellular frequencies studied.
  Source: https://pubmed.ncbi.nlm.nih.gov/16962663/

- **Tahir et al. (2024), developing inner ear —** Rats exposed during pregnancy and early development to 2.45 GHz signals at 5–15 V/m showed elevated auditory-response thresholds; at 10–15 V/m investigators also found increased cochlear apoptosis markers. All these field strengths are below the ~61.4 V/m plane-wave equivalent of the FCC public power-density reference at this frequency.

  Source: https://pubmed.ncbi.nlm.nih.gov/38454287/

- **Qin et al. (2019), circadian hormonal and immune effects —** Mice exposed to 1.8 GHz at 226 μW/cm² (0.226 mW/cm²), below the 1.0 mW/cm² public MPE, showed significant changes in stress hormones, immune factors and circadian secretion patterns.

  Source: https://pubmed.ncbi.nlm.nih.gov/31133139/

- **Fu et al. (2025), learning and memory in mice —** At 1.8 GHz and 240 μW/cm² (0.24 mW/cm²), below the 1.0 mW/cm² public MPE, RF-exposed mice showed learning and memory impairment and hippocampal changes. The authors also examined a compound that reduced these experimental effects.

  Source: https://pubmed.ncbi.nlm.nih.gov/40827634/

- **Pelletier et al. (2013), REM-sleep changes at very low intensity —** Juvenile rats continuously exposed for five weeks to 900 MHz at 1 V/m showed 42.1% more REM-sleep episodes at 24°C and 31.6% more at 31°C. The applied electric field was well below the corresponding FCC public far-field reference level.

  Source: https://pubmed.ncbi.nlm.nih.gov/23143821/

- **Pelletier et al. (2014), sleep and thermal preference —** In a separate experiment at 900 MHz and 1 V/m, juvenile rats showed greater slow-wave sleep and altered thermal preference. This provides additional evidence that low-intensity RF can interact with physiological sleep regulation under experimental conditions.

  Source: https://pubmed.ncbi.nlm.nih.gov/24905635/

- **Dode et al. (2011), cancer mortality near base-station clusters —** A geographic study reported higher cancer mortality close to base-station clusters in Belo Horizonte, Brazil. Reported area power densities were below the applicable U.S. cellular-band public MPE values, making the findings relevant to long-term community-exposure research.

  Source: https://pubmed.ncbi.nlm.nih.gov/21741680/

We urge the HHS to require transparent investigation and replication of these findings at verified below-limit exposures, including chronic nighttime exposure, simultaneous sources and exposure at schools. Federal agencies should publish the actual thresholds and health endpoints they consider protective, and provide counties with a meaningful role in reviewing site-specific health evidence. The studies raise concerns that merit precaution and independent research; they do not, individually or collectively, establish causation for every observed outcome.

Oxidative stress and downstream effects

Oxidative stress is a central concern in our request for protective action. Hundreds of peer-reviewed studies have demonstrated that low-intensity RF exposure can increase reactive oxygen species (ROS) while depleting endogenous antioxidants such as glutathione, superoxide dismutase, and catalase. This is not a trivial biochemical footnote. Oxidative stress is a unifying mechanism that links RF exposure to a wide range of downstream pathologies: DNA damage, lipid peroxidation, protein oxidation, mitochondrial dysfunction, and chronic inflammation. The implication is that even exposures far below the FCC's thermal threshold may, over time, contribute to neurodegenerative disease, cardiovascular illness, and cancer. The mechanistic plausibility of non-thermal harm is therefore not speculative; it is grounded in well-established redox biology.

Reproductive and developmental effects

Reproductive and developmental effects represent a second major area of concern. A substantial number of animal and human studies have reported reduced sperm motility, increased sperm DNA fragmentation, and altered hormone profiles following low-level RF exposure. These findings are particularly troubling because the developing fetus and the reproductive system are especially vulnerable to oxidative and endocrine disruption.

Epidemiological evidence

Epidemiological evidence adds further weight. Studies of populations living near cell towers, of heavy mobile phone users, and of occupational cohorts exposed to radar and RF welding equipment have reported elevated risks of glioma, acoustic neuroma, salivary gland tumors, and leukemia. The World Health Organization's International Agency for Research on Cancer classified RF electromagnetic fields as a Group 2B possible human carcinogen in 2011, a determination that has since been reinforced by additional studies. The pattern is consistent with a causal relationship, even if individual studies vary in design and statistical power. When the mechanistic, animal, and human evidence are triangulated, the case for non-thermal harm becomes difficult to dismiss as mere noise.

Electromagnetic hypersensitivity

We ask HHS to investigate electromagnetic hypersensitivity (EHS) and the experiences of people who report headaches, sleep disruption, cognitive impairment, tinnitus, skin sensations, and heart palpitations in proximity to Wi-Fi routers, cell towers, and mobile devices. Provocation studies have produced mixed results, and exposure conditions and individual responses are heterogeneous. We oppose dismissal of these symptoms as psychosomatic rather than investigation of possible physiological explanations. People experiencing these symptoms deserve serious public-health attention.

Children and developmental vulnerability

Children are uniquely vulnerable. Their skulls are thinner, their brain tissue is more conductive, and their developing nervous and immune systems are more susceptible to oxidative and genetic damage.

Yet the FCC's limits make no distinction between a fifty-year-old adult and a five-year-old child. The absence of age-specific safety factors is a serious regulatory failure.

Voltage-gated calcium channels and non-thermal mechanisms

We also ask HHS to investigate Martin Pall's proposed voltage-gated calcium channel (VGCC) mechanism. According to this model, low-intensity EMFs activate calcium channels in cell membranes, causing an influx of calcium ions that can trigger reactive oxygen species production, peroxynitrite formation, and mitochondrial dysfunction. Pall's work offers a proposed pathway connecting EMF exposure with symptoms such as chronic fatigue, headaches, sleep disturbance, and cognitive impairment. If this mechanism is correct, exposure standards centered only on heating would not address the pathway of concern. It should therefore be part of the non-thermal research agenda.

Question 13 — Cumulative exposure patterns by technology

According to scientific evidence, how do the technologies below affect cumulative exposure patterns? a. 5G. b. 6G. c. Wi-Fi. d. Satellite-based communications. e. Internet of Things (IoT). f. Wearable technologies. g. Smart homes/appliances. h. Smart cities. i. Autonomous vehicles. j. Wireless medical devices. k. Communication enabled smart meters.

Our association is concerned about the cumulative exposure created by overlapping wireless technologies. Exposure is a dynamic function of the number of radiating sources, their power densities, their proximity to the body, and the duration of exposure. We ask HHS to consider the following technologies together as well as individually, including the concerns described in the BioInitiative Report and in Scientists and Doctors Warn of Potential Serious Health Effects of 5G. [1, 4]

13.a — 5G

5G represents the most significant architectural change in wireless communications in decades. Unlike earlier cellular generations that relied primarily on large macrocells, 5G deploys dense small-cell networks, massive multiple-input multiple-output antenna arrays, and beamforming that concentrates radiation in narrow, steerable beams. Because small cells are placed closer to homes, schools, and workplaces, the distance between the human body and the nearest transmitter shrinks dramatically. Cumulative exposure therefore rises not only from the number of transmitters but from the reduced distance to each one. The BioInitiative Report documents that proximity is a critical determinant of absorbed dose, meaning that a small cell mounted on a utility pole outside a bedroom window can produce exposure comparable to or greater than a distant macrocell tower operating at far higher power.

13.b — 6G

6G, still in research and standardization phases, is expected to operate in the terahertz and sub-terahertz bands and to integrate terrestrial networks with satellite constellations. Because terahertz radiation is absorbed superficially by the skin and cornea, the biological interaction profile differs from that of microwave frequencies, yet the cumulative principle remains unchanged. A 6G environment would

layer new frequencies on top of existing 4G, 5G, Wi-Fi, and satellite emissions rather than replacing them. The GreenMedInfo.com authors emphasize that each generational transition has historically added to, not subtracted from, the total ambient RF burden, and there is no scientific basis to assume 6G will reverse that pattern.

13.c — Wi-Fi

Wi-Fi networks operate in the 2.4 and 5 gigahertz bands and are now ubiquitous in homes, schools, libraries, transit hubs, and commercial spaces. A typical urban household may contain a router, smart speakers, streaming devices, and a mesh network, each continuously beaconing. Cumulative exposure from Wi-Fi is characterized by its constancy rather than its peak intensity. The BioInitiative Report notes that continuous low-level exposure may be more biologically relevant than intermittent high-level exposure because the body has no recovery period. Wi-Fi therefore functions as a baseline layer upon which cellular and satellite exposures are superimposed.

13.d — Satellite-based communications

Satellite-based communications add a genuinely global dimension to cumulative exposure. Low-earth-orbit constellations numbering in the tens of thousands of satellites are designed to provide continuous coverage, meaning that at any point on Earth's surface multiple satellites may be within line of sight. The GreenMedInfo.com authors specifically identify satellite-based communications as a driver of substantially increased long-term RF-EMF exposure for all citizens. Because satellite signals must penetrate the atmosphere and reach receivers at ground level, they contribute an unavoidable ambient floor of exposure that no individual can opt out of by turning off a personal device.

13.e — Internet of Things

Internet of Things devices multiply the number of transmitters within any given environment. Smart sensors, industrial monitors, agricultural telemetry, and consumer gadgets each maintain network connections, often with periodic uplink transmissions. The GreenMedInfo.com publication quantifies this at 10 to 20 billion connections, a figure that translates directly into a proportional increase in the density of radiating sources. The cumulative effect is not merely additive but multiplicative, because each device increases both the number of sources and the likelihood that a person is within close range of at least one active transmitter at all times.

13.f — Wearable technologies

Wearable technologies place transmitters directly against or within centimeters of the human body. Smartwatches, fitness trackers, wireless earbuds, and continuous glucose monitors transmit data via Bluetooth, Wi-Fi, or cellular links. Because the inverse-square law governs RF field intensity, a transmitter at wrist or ear distance produces absorbed energy orders of magnitude greater than the same transmitter at several meters. The BioInitiative Report emphasizes that body-worn devices raise specific concerns because there is no distance attenuation to protect the user. Cumulative exposure from wearables is therefore disproportionately large relative to their small size.

13.g — Smart homes and appliances

Smart homes and appliances embed wireless connectivity into the domestic environment. Refrigerators, thermostats, doorbells, security cameras, lighting systems, and voice assistants each maintain network links. The cumulative exposure profile of a smart home is one of overlapping, continuous fields in which the occupant is never beyond the reach of at least one transmitter. The GreenMedInfo.com authors note that this domestic saturation represents a qualitative change from earlier eras in which the home was a refuge from external RF sources. The smart home reverses that relationship, making the interior environment a primary exposure site.

13.h — Smart cities

Smart cities extend the same logic to public space. Traffic sensors, smart streetlights, surveillance networks, and municipal Wi-Fi create an outdoor environment in which RF exposure is continuous and involuntary. The GreenMedInfo.com publication warns that such infrastructure substantially increases long-term RF-EMF exposure for all citizens regardless of personal choice.

13.i — Autonomous vehicles

Autonomous vehicles rely on radar, lidar, and vehicle-to-everything communications that operate continuously while the vehicle is in motion. A single autonomous vehicle may emit multiple radar beams in different directions simultaneously, and a roadway filled with such vehicles creates a moving field of RF exposure. The cumulative dimension here is spatial and dynamic: exposure varies with traffic density, vehicle speed, and proximity to pedestrians and cyclists. The BioInitiative Report's emphasis on the biological relevance of non-thermal exposure applies directly to this case, because radar pulses are typically brief but repeated at high frequency.

13.j — Wireless medical devices

Wireless medical devices introduce exposure in a context where the patient may already be medically vulnerable. Implantable cardiac monitors, insulin pumps, and remote patient monitoring systems transmit health data wirelessly. The cumulative exposure from these devices is continuous and, unlike consumer electronics, cannot be removed at will. The BioInitiative Report documents that vulnerable populations, including the elderly and the immunocompromised, may be more susceptible to RF-EMF effects. Wireless medical devices therefore raise the stakes of cumulative exposure precisely where the margin for error is smallest.

13.k — Communication-enabled smart meters

Communication-enabled smart meters represent a mandatory layer of exposure for many utility customers. Unlike personal devices, smart meters are installed by utility companies and cannot be refused in many jurisdictions. They transmit periodic data bursts, often several times per hour, and in mesh configurations they may relay data from neighboring meters. The cumulative exposure from smart meters is thus both involuntary and networked. The GreenMedInfo.com authors identify smart meters as part of the broader infrastructure that substantially increases long-term RF-EMF exposure for all citizens.

Question 14 — Potential environmental effects

What scientific evidence exists regarding potential adverse environmental effects associated with RF radiation?

We ask HHS to consider reports of disorientation, disrupted navigation, and reduced reproductive success in birds exposed to electromagnetic fields at intensities below international safety thresholds. The role of magnetoreception in avian migration and foraging makes these concerns particularly important. Wildlife protection must not be treated as incidental to the assessment of wireless radiation.

Pollinators

Insect pollinators represent another critical concern. Several laboratory studies have shown that RF exposure can disrupt the behavior, reproduction, and cellular physiology of bees and other pollinators. Given the already precarious state of global pollinator populations — threatened by pesticides, habitat loss, and disease — the addition of electromagnetic pollution constitutes an unacceptable cumulative risk. The precautionary principle demands that we not wait for colony collapse to be definitively linked to cell towers before taking action.

Plant and animal cellular effects

Independent researchers have reported oxidative stress, DNA damage, and disruption of calcium signaling in plant and animal cells exposed to RF fields. We ask HHS to give these findings serious consideration in evaluating environmental effects.

Environmental standards and ecosystem assessment

We do not consider a framework centered on tissue heating adequate for environmental risk assessment. HHS should address non-thermal biological effects and chronic, low-level exposure as well as acute thermal effects.

Ecosystem-level effects are inherently difficult to study because of the interconnectedness of species and the multiplicity of environmental stressors.

We request support for decentralized, community-based monitoring and independent ecological research. The complexity of ecosystem-level effects should lead to precaution and sustained investigation, not dismissal of potential harm.

Question 15 — Evidence relevant to wireless infrastructure

What types of scientific evidence should be considered when evaluating RF exposure associated with wireless infrastructure? Please comment on: a. proximity to homes, schools, childcare facilities, healthcare facilities, and/or workplaces. b. cumulative neighborhood exposure. c. antenna density. d. small-cell deployment. e. livestock.

We ask HHS to evaluate wireless infrastructure through a framework grounded in real-world exposure conditions. The evaluation should address proximity to sensitive locations, cumulative neighborhood exposure, antenna density, small-cell deployment, and livestock. The ecological risk-assessment

approach described by J.H. Gentile and colleagues emphasizes the spatial scale of a stressor and its co-occurrence with ecological components of concern. We support applying that approach to RF infrastructure: the question is not merely whether one antenna complies with a power-density limit, but whether aggregate exposure from antennas at different distances and frequencies produces biological effects in people and animals. [10]

15.a — Proximity to occupied and sensitive locations

Proximity to homes, schools, childcare facilities, healthcare facilities, and workplaces is a primary determinant of exposure. Children and fetuses are particularly vulnerable because their developing nervous systems and thinner skulls allow deeper penetration of RF energy. A school or childcare center located within a few hundred meters of a cell tower or a dense cluster of small cells represents a population with continuous, involuntary exposure during critical developmental windows. Similarly, hospitals and clinics house patients with compromised immune systems, implanted medical devices, and neurological conditions that may be aggravated by electromagnetic fields. Workplaces add another layer: employees in offices, warehouses, and factories near rooftop antennas or distributed antenna systems may receive cumulative exposures that exceed what any single measurement captures. The scientific literature on non-thermal biological effects, including oxidative stress, DNA damage, and disruption of calcium signaling, suggests that distance-based safety thresholds alone are inadequate. Available data does not confirm that current FCC limits protect these sensitive subpopulations, because those limits were derived from short-term thermal effects in adult male subjects, not from chronic exposure in children or the ill.

15.b — Cumulative neighborhood exposure

Cumulative neighborhood exposure is the second critical dimension. RF energy does not respect property lines or regulatory jurisdictions. A resident may live near a macro cell tower, a small-cell pole, a smart meter, and a Wi-Fi router, all operating simultaneously across multiple frequency bands. The cumulative effect of these sources is rarely measured or modeled by regulators, who typically evaluate each antenna or device in isolation. This fragmented approach ignores the principles of exposure characterization outlined in ecological risk assessment, where the spatial and temporal co-occurrence of multiple stressors must be evaluated together. In practice, cumulative exposure can create hotspots where the total power density is significantly higher than any single source would produce. Communities have reported clusters of symptoms, including sleep disruption, headaches, tinnitus, and cardiac arrhythmias, that correlate with the activation of new antennas.

15.c — Antenna density

Antenna density is the third factor. The number of antennas per unit area determines the spatial density of RF energy, and density matters more than the power of any individual transmitter for chronic exposure. A single high-power tower may produce a predictable radiation pattern, but dozens of low-power small cells mounted on utility poles, streetlights, and buildings create an unpredictable and constantly changing electromagnetic environment. Each small cell may operate at lower power, but the sheer number of them means that a pedestrian, a delivery worker, or a child walking to school is never

far from a transmitter. The cumulative effect of antenna density is analogous to the difference between one loudspeaker and a stadium full of them: the sound pressure at any point is the sum of all sources. Regulatory models that assume a single dominant source systematically underestimate exposure in dense deployments. Independent measurements in urban and suburban neighborhoods have found ambient RF levels far above what official models predict, particularly in areas where small cells have been installed on every block.

15.d — Small-cell deployment

Small-cell deployment deserves particular scrutiny because it represents a qualitative shift in infrastructure. Unlike macro towers, small cells are designed to be ubiquitous, mounted at street level or on low poles, often within meters of homes and sidewalks. This proximity means that the far-field assumptions used in thermal safety calculations may not apply; people can be in the near field of an antenna, where the spatial peak specific absorption rate (SAR) can be much higher than the whole-body average. The deployment of 5G small cells in the 24 GHz and higher bands introduces additional concerns because higher frequencies are absorbed more readily by the skin and the cornea, and because the beamforming technology concentrates energy into narrow beams that can track users. The Federal Register request specifically asks about wireless technology, and small cells are the backbone of the next generation of wireless infrastructure. A scientific evaluation must therefore include near-field dosimetry, beam-tracking exposure variability, and the biological effects of millimeter waves, none of which are adequately addressed by existing compliance testing.

15.e — Livestock

Livestock are an often-overlooked but scientifically important population. Farm animals are frequently exposed to RF fields from cell towers, Wi-Fi systems, and RFID tags used for identification and milking. Studies from Europe and North AmericaKey statements to address in comments on wireless radiation exposure rules

ET Docket No. 13-84 • Public Notice DA 26-997 • Comments due October 22, 2026

Use this guide to respond directly to the FCC’s questions about its radiofrequency radiation exposure rules. It pairs key statements from the notice with recommendations and sample responses. Choose the sections that fit your knowledge or experience, support your points with specific evidence, and explain what you want the FCC to do.

Links

FCC Notice released on September 17

FCC Notice in the Federal Register.

FCC Portal to Submit

Submit an express comment (type a short comment into website)

Submit a standard comment (upload PDFs)

The notice concerns the court's remand in the 2021 Court Case Environmental Health Trust et al. v. FCC. Its stated scope is evidence properly before the court from the 2013–2019 inquiry, addressing noncancer health effects, children, long-term exposure, the ubiquity of wireless technology and changes since 1996, cell phone and portable-device testing systems, and environmental impacts. Stay on these issues. The notice does not open every RF policy question for reconsideration.

 have reported adverse effects on dairy cattle, including reduced milk yield, behavioral changes, reproductive problems, and increased incidence of mastitis and lameness in herds near cell towers. These effects have economic and animal-welfare implications, and they also provide sentinel evidence for human health risks. If RF exposure at levels below thermal thresholds can disrupt the physiology of large mammals, the assumption that such exposure is harmless to humans becomes untenable. The ecological risk assessment framework is again relevant: livestock are part of the ecosystem, and their exposure co-occurs with human exposure in rural and peri-urban areas. A complete scientific evaluation must therefore include veterinary and agricultural studies, not just human epidemiological research.

We ask HHS to give weight to independent research that examines non-thermal endpoints, measures real-world exposure, and is free from financial ties to telecommunications companies.

Question 16 — Priority research gaps

What are the highest priority research gaps regarding EMF and RF radiation and public health that the federal health agencies should address?

We urge HHS to adopt the following research priorities as an integrated public-health program. Research on exposure, mechanisms, vulnerable populations, and mitigation should proceed together, supported by independent funding and transparent methods.

Real-world dosimetry

We consider comprehensive, independent dosimetry of real-world exposures a first priority. Research should reflect the pulsed, multi-frequency environments in which people live, rather than depend primarily on controlled laboratory exposures. We request a national database of cumulative RF exposure in homes, schools, workplaces, and public spaces, together with research connecting exposure assessment to biological measurements.

We ask HHS to support wearable dosimeters in representative populations, continuous monitoring near 5G infrastructure, and transparent publication of raw measurement data.

Non-thermal biological effects

The second gap concerns non-thermal biological effects, particularly oxidative stress, DNA damage, blood-brain barrier permeability and endocrine disruption.

We request independent replication of oxidative-stress and genotoxicity findings using blinded protocols and preregistered hypotheses.

Sensitive populations and electrosensitivity

We request long-term epidemiological studies of children, pregnant women, older adults, and people with preexisting neurological or immune conditions. Electrosensitivity should be included in the research and surveillance agenda rather than left outside it.

We ask HHS to make research data available for independent reanalysis rather than relying on industry-sponsored summaries.

Cumulative and synergistic effects

We request research into cumulative and synergistic effects. People encounter RF radiation alongside extremely low-frequency fields from power lines and appliances, dirty electricity, and environmental toxicants. These exposures should be studied in combination rather than only in isolation.

Exposure mitigation

We ask HHS to investigate mechanisms of harm alongside measures that may reduce exposure, including shielding technologies, wiring practices, building materials, and public-health interventions. Research into possible non-thermal effects should lead to evaluation of practical mitigation.

The comparative effectiveness research principles articulated by Sox and colleagues require that studies assist consumers, clinicians and policy makers in making informed decisions that improve health care at both individual and population levels. [11]

Neurological and psychiatric outcomes

We request research on neurological and psychiatric outcomes, including sleep disruption, cognitive impairment, anxiety, depression, and neurodegenerative conditions. Independent studies linking wireless radiation to these outcomes warrant a dedicated response from the federal research agenda.

Prenatal and childhood development

We request research on prenatal and early-childhood exposure in relation to developmental outcomes, including autism spectrum disorders, attention deficit hyperactivity disorder, and learning disabilities. These questions deserve prospective investigation and long-term follow-up.

We recommend prospective birth-cohort studies with comprehensive exposure assessment, independent neurodevelopmental testing, and long-term follow-up.

Occupational exposure

The eighth gap is the lack of research on occupational exposures. Telecommunications workers, utility linemen, military personnel operating radar and communications equipment, and employees in smart buildings face elevated RF exposures.

We ask HHS to prioritize occupational cohort studies with verified exposure measurements and comprehensive health-outcome tracking.

Medical devices and pharmaceuticals

We request systematic research on interactions with implanted medical devices and pharmaceuticals, including pacemakers, insulin pumps, neurostimulators, and possible effects on drug metabolism through non-thermal mechanisms. Real-world device performance, post-market surveillance, and drug-device-EMF interactions should be part of a coordinated patient-safety research program.

Independent research governance

We ask HHS to establish a transparent, independent, adequately funded RF/EMF research program free from industry influence. Such a program is necessary to address all of these priorities consistently.

We support Sox and colleagues' call for research to meet the highest scientific and ethical standards, including public disclosure of competing interests. [11]

Question 17 — Coordination among federal health agencies

How can federal health agencies improve coordination of EMF and RF radiation research? Please comment on potential roles for federal health agencies including, but not limited to: a. HHS Food and Drug Administration (FDA). b. HHS National Institutes of Health (NIH). c. HHS Centers for Disease Control and Prevention (CDC).

We ask HHS to establish a coordinated RF/EMF public-health program with clear responsibilities for the FDA, NIH, and CDC, sustained public participation, and independence from the industries whose products are being assessed.

17.a — FDA

We ask HHS to make independent safety assessment the FDA's central role in RF/EMF coordination. We are concerned about conflicts between protecting public health and promoting regulated products, including consumer devices that emit RF radiation. Safety evaluation should not be shaped by an institutional presumption that expanding use of these products is the preferred outcome.

We advocate separating the FDA's RF safety assessment from product-promotion interests and excluding industry-funded science from control over that assessment.

17.b — NIH

We ask HHS to make full use of the NIH's research infrastructure for rigorous, long-term RF/EMF studies and to give this field a dedicated priority.

We recommend a dedicated NIH office for electromagnetic safety research, free from telecommunications-industry influence. It should coordinate multisite epidemiological studies following health outcomes in populations living near cell towers and 5G infrastructure.

17.c — CDC

We ask HHS to assign the CDC a central role in public-health surveillance of RF/EMF exposure and related health complaints, including sleep disruption, headaches, cognitive impairment, and electrohypersensitivity.

We recommend that the CDC lead a national registry for EMF and RF exposure and associated health reports, providing a foundation for public-health policy.

Joint coordination and legislative recommendations

We ask the FDA, NIH, and CDC to coordinate around health protection and precaution, not a presumption that wireless technology is safe until citizens establish otherwise. Industry should bear the burden of demonstrating safety. The agencies should jointly recommend that Congress amend the Telecommunications Act to restore the ability of local communities to consider health and environmental impacts in wireless siting and zoning decisions.

We ask HHS to make public participation central to this coordination.

We recommend citizen advisory boards for RF/EMF research that include independent scientists, environmental-medicine practitioners, and representatives of communities affected by wireless infrastructure.

We recommend a geographic-information-system approach to coordination, drawing on the Land-Use Deconfliction Process (LUDP) at Fort Lewis, Washington. A similar approach could map RF exposure hotspots, identify sensitive populations, visualize conflicts, and coordinate federal, state, and local responses. The CDC's National Center for Environmental Health should develop this mapping capability with the NIH and FDA. [12]

We ask HHS to build coordination on independence, transparency, and accountability to the public rather than to industry.

Question 18 — Additional evidence and recommendations

Please identify any additional scientific evidence, technical information, data, or recommendations that federal health agencies should consider when evaluating potential adverse health effects associated with RF/EMF radiation exposure.

We ask HHS to give appropriate weight to mechanistic and in vitro studies alongside epidemiological research, particularly where proposed mechanisms are biologically plausible and reproducible.

We ask HHS to commission independent reanalyses of existing datasets, including raw data from industry-funded studies that have never been made publicly available.

Real-world exposure and sensitive populations

We ask HHS to require comprehensive field measurements using calibrated broadband and frequency-selective instruments, conducted by independent researchers without industry funding. These measurements should be made in homes, schools, workplaces, and public spaces, and should account for simultaneous exposure from multiple sources.

We ask HHS to fund research that uses objective biomarkers, not just subjective questionnaires, and to recognize that absence of a proven mechanism does not mean absence of harm.

We ask HHS to require child-specific exposure limits and to fund longitudinal studies tracking children's health outcomes in relation to wireless exposure from infancy onward.

We ask HHS to prioritize research on reproductive toxicity and to require that wireless devices be tested for these endpoints before being marketed.

Independent standards and accountability

We ask HHS to convene an independent panel, free from industry conflicts of interest, to review all available evidence and recommend new, biologically based exposure limits.

We ask HHS to consider the recommendations of independent scientists and public-health advocates, including the BioInitiative Report, the International EMF Scientist Appeal, and the EMF Working Group. Their calls for stricter exposure limits, greater precaution, reduced exposure for children and pregnant women, and independent research deserve serious consideration. [1]

We ask HHS to require full financial disclosure from all advisors and to exclude anyone with industry ties from decision-making roles. Transparency is not optional; it is a prerequisite for credible science.

Moratorium and wired alternatives

We support a moratorium on further 5G deployment until independent safety testing is completed, together with a comprehensive environmental-impact review. The cumulative consequences of expanding antenna infrastructure near homes and schools should be evaluated before further involuntary exposure is imposed. We also ask HHS to promote wired alternatives, including fiber optics and Ethernet, rather than treating wireless deployment as the only path to connectivity. The federal government should prioritize public health and environmental protection over commercial expansion.

International scientist appeal

More than 230 scientists in 41 nations studying the biological and health effects of nonionizing EMFs signed an international appeal to the United Nations calling for immediate protective action, as reported by Mercola.com in January 2019. We ask HHS to engage directly with these calls for health-protective exposure standards and independent research. [6]

Closing request

Bald Hill Pure and Clear Skies Association urges HHS to translate this inquiry into concrete public-health protection: biologically based standards, independent and sustained research, transparent exposure information, protection for sensitive populations, environmental assessment, and meaningful choices that reduce involuntary exposure.

We ask HHS to work with the appropriate federal agencies and Congress to restore meaningful local participation, promote wired alternatives, and ensure that public health takes precedence over commercial deployment. Scientific uncertainty should be addressed through precaution, transparency, and independent investigation, not treated as a reason to withhold protection.

Respectfully submitted,

Bald Hill Pure and Clear Skies Association

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