Response to the U.S. Department of Health and Human Services Request for Information on Electromagnetic Fields (EMFs), Radiofrequency (RF) Radiation, and Wireless Radiation Exposure

Docket No. HHS-OASH-2026-0397

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Perspective Represented

I am submitting this response as a building biology and environmental health professional with extensive experience evaluating residential environments for electromagnetic fields (EMFs), radiofrequency (RF) radiation, indoor air quality, mold, and other environmental exposures.

For many years, I have worked directly with thousands of individuals and families who are concerned about environmental exposures in their homes and workplaces. A significant component of my professional practice involves evaluating electromagnetic environments and helping individuals reduce unnecessary exposure to electrical and wireless sources.

My perspective is based on:

- Thousands of real-world client observations
- Direct measurement of electromagnetic environments
- Evaluation of residential exposure patterns
- Professional training in building biology and environmental health
- Review of peer-reviewed scientific literature
- Observation of changes reported by clients following environmental exposure reduction
- My own personal experience with electromagnetic exposure and exposure reduction

I am not submitting this comment to claim that every symptom attributed to EMF/RF exposure is caused by EMF/RF exposure. I recognize that symptoms such as headache, fatigue, sleep disturbance, cognitive difficulties, dizziness, palpitations, and sensory symptoms have many possible causes.

My concern is that the current scientific and public-health discussion can sometimes move too quickly from “causation has not been conclusively established” to “there is no meaningful biological effect.” Those are not equivalent conclusions.

I believe the available evidence, combined with extensive real-world observations, warrants substantially more rigorous investigation of chronic, cumulative, and biologically relevant RF/EMF exposures.

1. Real-World Human Experience Should Be Considered a Signal for Research

HHS specifically requests information from healthcare professionals, public-health practitioners, and others with direct experience regarding potential adverse health effects associated with RF/EMF exposure. The RFI also asks respondents to describe exposure patterns, reported symptoms, timing, exposure reduction, and observed changes following exposure reduction.

This is an important opportunity because the people I encounter in my professional practice are living in environments fundamentally different from the controlled exposure scenarios used in many laboratory studies.

Modern homes can contain multiple simultaneous RF sources, including:

• Wi-Fi routers and access points
• Cell phones
• Bluetooth devices
• Wireless computers and peripherals
• Smart televisions
• Wireless security systems
• Smart appliances
• Smart meters
• Wearable technologies
• Wireless medical devices
• Cellular infrastructure
• IoT devices

The exposure may be intermittent, continuous, pulsed, modulated, localized, whole-body, near-field, far-field, or some combination of these.

The individual may also be exposed for many hours per day and potentially for decades.

I believe this distinction is critical. A laboratory study evaluating one exposure condition for a short period cannot necessarily answer the question of what may occur after years of repeated exposure to multiple modulated RF sources.

2. The Scientific Evidence Is Not Appropriately Characterized as "No Evidence of Biological Effects"

There is substantial scientific evidence demonstrating that RF exposure can produce biological effects. The more difficult scientific question is determining which effects are adverse, under what exposure conditions they occur, whether they translate into clinically meaningful outcomes in humans, and what exposure characteristics determine risk.

This distinction matters.

The National Toxicology Program conducted large, long-term animal studies of 2G and 3G cell-phone RF radiation. NTP reported clear evidence of an association between high RF exposure and malignant schwannomas of the heart in male rats, as well as some evidence of malignant gliomas of the brain and tumors of the adrenal gland. The studies were specifically designed to evaluate biological effects at exposure levels that did not significantly raise body temperature.

These findings do not establish that ordinary human cell-phone use causes these cancers.

However, they demonstrate why it is scientifically inappropriate to frame RF radiation research solely around the question of whether exposure produces measurable tissue heating.

The NTP research demonstrates that biologically relevant outcomes have been observed in controlled animal experiments at exposures that were not simply explained by gross thermal injury.

3. Recent WHO-Commissioned Research Makes Further Investigation Particularly Important

The World Health Organization has undertaken a large international effort to systematically evaluate RF-EMF research across cancer, oxidative stress, cognitive effects, symptoms, reproductive outcomes, and other biological endpoints.

Several of the resulting systematic reviews are particularly relevant.

Cancer

A 2024 WHO-commissioned systematic review of human observational studies evaluated RF exposure and cancer risk. The authors reported that the evidence varied substantially by exposure source and

cancer outcome and emphasized the limitations and uncertainty associated with available studies. For several outcomes, the certainty of evidence remained low.

This uncertainty should not be interpreted as proof of safety.

At the same time, it is important to accurately characterize the findings rather than claiming that human epidemiology has established a causal relationship.

In addition, IARC classified RF-EMF as Group 2B, “possibly carcinogenic to humans,” in 2011. IARC's classification was based on limited human evidence together with supporting experimental and mechanistic evidence; it did not establish that RF exposure causes cancer in humans.

Animal cancer evidence has continued to develop since that classification.

A 2025 systematic review of experimental animal studies found high certainty evidence for heart schwannomas and moderate certainty evidence for brain gliomas in the reviewed animal literature. The authors also noted that translating animal findings into human risk requires careful consideration of exposure metrics, intensity, duration, cumulative exposure, and mechanisms.

This is precisely why additional research is needed.

Oxidative Stress

A 2024 systematic review of 56 experimental studies examining RF-EMF and biomarkers of oxidative stress found evidence across numerous animal and cellular studies, although the authors rated the overall certainty of evidence as limited because of substantial methodological concerns and risk of bias.

This is an important research area because oxidative stress is biologically relevant to numerous disease processes.

The appropriate conclusion is not that RF-EMF has been proven to cause oxidative stress-related disease in humans. Rather, the evidence provides a biologically plausible area for continued investigation, particularly using standardized exposure conditions, rigorous dosimetry, blinded outcome assessment, and independent replication.

Genotoxicity

A 2024 systematic review of RF-EMF genotoxicity in mammalian cells similarly found a heterogeneous literature with methodological limitations. The existence of inconsistent results should be treated as a research problem rather than simply dismissing the question.

Because DNA damage and genomic instability are important biological endpoints, I believe this area warrants continued investigation using standardized exposure protocols and carefully controlled studies.

Reproductive Health

RF-EMF exposure has also been investigated in relation to reproductive outcomes.

A 2024 WHO-associated systematic review of experimental studies involving male fertility included 117 animal studies and 10 studies involving human sperm in vitro. The review found evidence of adverse effects in several animal reproductive endpoints, including reduced pregnancy rates and sperm count, although the certainty of evidence varied and many studies had important methodological limitations. The authors specifically called for better exposure characterization, multiple exposure levels, and improved study design.

These findings should not be represented as proof that typical human wireless exposure causes infertility. However, they provide sufficient scientific rationale to continue studying reproductive effects, particularly because exposure is now widespread and begins at increasingly young ages.

4. Symptoms and Electromagnetic Sensitivity Require Better Research

This is one of the areas most closely connected to my professional experience.

I have worked with many individuals who report symptoms that they associate with electromagnetic environments, including:

• Headaches
• Sleep disruption
• Fatigue
• Cognitive difficulties
• Dizziness
• Palpitations
• Neurological or sensory symptoms
• Difficulty concentrating
• Feelings of physiological overstimulation

Some individuals report improvement when they substantially reduce their exposure.

I recognize that controlled provocation studies have not consistently demonstrated that people who identify as electromagnetically sensitive can reliably detect RF exposure under blinded conditions.

A 2024 systematic review of human experimental studies involving self-reported symptoms found no significant or consistent effects for the primary symptom outcomes examined, although certainty varied by outcome.

This is important evidence and should not be ignored.

However, I do not believe it completely resolves the public-health question.

The research question should not be limited to: “Can a person consciously identify whether a particular RF source is switched on?”

A more useful research question is: “Do some individuals exhibit measurable physiological responses to particular electromagnetic exposure conditions, and if so, what exposure characteristics and biological mechanisms are involved?”

Those are different questions.

I encourage HHS to investigate this population using objective physiological measurements rather than relying solely on subjective symptom reporting or the ability to identify an exposure.

Potential research endpoints could include:

• Heart-rate variability
• Autonomic nervous system activity
• Sleep architecture
• EEG measurements
• Cortisol and other stress-response markers
• Oxidative-stress biomarkers
• Inflammatory biomarkers
• Mitochondrial function
• Neurological measures
• Cardiovascular parameters
• Objective cognitive testing
• Melatonin and circadian biology
• Reproducible exposure-response relationships

This would move the discussion beyond an argument about whether symptoms are “real” and toward the scientifically testable question of whether measurable physiological responses occur under controlled exposure conditions.

5. Exposure Standards Should Consider More Than SAR and Thermal Effects

HHS specifically asks how exposure classification should account for operating frequency, power density, SAR, electric and magnetic field strength, modulation, pulse characteristics, duty cycle, beamforming, simultaneous exposure to multiple frequencies, duration, distance, proximity to the body, and cumulative exposure.

I strongly support this broader approach.

Exposure assessment should not rely on a single number.

Two environments can have the same average power density while having substantially different exposure characteristics.

Important variables include:

- Frequency
- Signal modulation
- Pulsing
- Duty cycle
- Peak versus average exposure
- Duration
- Distance
- Near-field versus far-field exposure
- Body location
- Simultaneous exposure from multiple sources
- Cumulative exposure
- Changes in exposure over time
- Environmental reflections and building characteristics
- Individual device transmit power
- Adaptive power control
- Network traffic
- Beamforming and dynamic transmission characteristics

These variables deserve consideration in both research and risk assessment.

6. Real-World Exposure Measurement Needs Significant Improvement

This is an area where my professional experience is particularly relevant.

When I evaluate a home, I am not simply interested in whether one wireless device technically complies with a particular manufacturer's specification. I am interested in what the person is actually exposed to in the environment where they live and sleep.

Exposure can vary dramatically from room to room.

A bedroom may have very different exposure characteristics from a living room.

A person sleeping next to a wireless router, phone, smartwatch, or other transmitting device may have a substantially different exposure pattern than someone using the same technology intermittently at a distance.

Therefore, research should incorporate actual environmental measurements whenever possible.

I recommend greater use of:

- Long-duration personal exposure monitoring
- Residential measurements
- Bedroom measurements
- School measurements
- Occupational measurements
- Time-resolved exposure measurements

• Frequency-specific measurements
• Simultaneous multi-band measurements
• Peak and average measurements
• Distance and body-proximity measurements
• Geographic and neighborhood exposure mapping
• Personal exposure diaries linked to objective measurements

The HHS RFI specifically recognizes the importance of real-world exposure conditions, and I believe this should become a major federal research priority.

7. Cumulative Exposure Should Be Treated as a Central Research Question

Modern wireless exposure cannot reasonably be understood by studying one device at a time.

An individual may simultaneously encounter:

Wi-Fi + cellular + Bluetooth + smart meter + wearable technology + wireless appliances + nearby cellular infrastructure.

Each source may operate at different frequencies, intensities, modulation patterns, duty cycles, and distances.

The resulting exposure is dynamic.

I therefore encourage HHS to develop research methodologies capable of evaluating cumulative and simultaneous exposures.

This should include studies of multiple real-world technologies operating concurrently.

It should also include exposure during sleep because nighttime exposure may represent a particularly important period of continuous or prolonged exposure.

8. Children Deserve Specific Consideration

HHS specifically identifies children as a potentially sensitive population.

I strongly support additional research involving children.

Children are not simply smaller adults.

They are undergoing neurological, physiological, and developmental changes and may experience decades of cumulative exposure.

Research should therefore examine:

• Prenatal exposure
• Early childhood exposure
• School environments
• Wireless classroom technology
• Mobile device use
• Wearable devices
• Sleep-time exposure
• Developmental and neurological outcomes
• Long-term cumulative exposure

The evidence is not sufficiently established to conclude that typical wireless exposure is causing developmental harm. But neither is it scientifically appropriate to assume that children have identical exposure-response characteristics to adults without adequately studying the question.

9. Research Should Be Independent, Transparent, and Reproducible

Because RF/EMF research has generated substantial disagreement, federal agencies should prioritize research with:

- Full disclosure of funding sources
- Independent replication
- Pre-registered protocols
- Standardized exposure characterization
- Blinded outcome assessment
- Transparent statistical methods
- Complete reporting of null results
- Accurate dosimetry
- Independent verification of exposure systems
- Clearly defined biological endpoints
- Long-term follow-up where appropriate
- Standardized terminology

One of the major challenges in this field is that studies often differ substantially in frequency, modulation, exposure intensity, duration, SAR, biological model, and outcome measurement.

This makes comparisons difficult.

Federal agencies could make a major contribution by establishing standardized protocols that allow results from different laboratories to be meaningfully compared.

10. Research Should Not Assume That SAR Is the Only Relevant Dose Metric

I believe this deserves particular attention.

SAR is an important exposure metric, but the scientific question should remain open as to whether SAR alone adequately characterizes all biologically relevant effects of RF/EMF exposure.

HHS should investigate whether additional exposure characteristics may be relevant, including:

- Frequency
- Modulation
- Pulse characteristics
- Peak exposure
- Duration
- Duty cycle
- Distance
- Body proximity
- Multiple simultaneous frequencies
- Cumulative exposure
- Spatial distribution of exposure
- Temporal variability

The 2025 animal cancer systematic review specifically noted unresolved questions concerning the appropriate exposure metric, intensity, cumulative exposure, and whether SAR is sufficient for evaluating adverse effects.

This is an important area for federal research.

11. My Recommendation for a Practical Public-Health Approach

I do not believe the government needs to wait for every scientific question to be resolved before providing practical exposure-reduction information.

People can reduce unnecessary RF exposure through relatively simple measures, including:

• Increasing distance from transmitting devices
• Using wired internet connections where practical
• Turning off wireless functions when they are not needed
• Avoiding unnecessary wireless devices
• Avoiding prolonged close-body exposure to transmitting devices
• Keeping phones away from the body when practical
• Avoiding placement of transmitting devices immediately adjacent to the bed
• Providing wired alternatives in schools and workplaces when practical

These measures do not require the government to declare that RF radiation is proven to cause a particular disease.

They simply provide people with information that allows them to reduce unnecessary exposure while scientific questions continue to be investigated.

12. Recommended Federal Research Priorities

Based on my professional experience and review of the scientific evidence, I recommend that HHS prioritize:

1. Long-term human cohort studies incorporating objective exposure measurements.
2. Long-duration personal RF exposure monitoring.
3. Studies of cumulative exposure from multiple simultaneous wireless sources.
4. Research into biological effects below current exposure limits.
5. Research examining modulation, pulsing, duty cycle, and signal characteristics.
6. Independent replication of significant animal and laboratory findings.
7. Long-term cancer surveillance.
8. Research into oxidative stress and cellular signaling.
9. Research into neurological and cognitive outcomes.
10. Research into sleep and circadian biology.
11. Research into reproductive and developmental outcomes.
12. Research involving children and adolescents.
13. Research involving individuals who report electromagnetic sensitivity.
14. Objective physiological testing of individuals reporting symptoms associated with RF/EMF exposure.
15. Development of standardized real-world exposure measurement protocols.
16. Investigation of cumulative neighborhood exposure.
17. Improved monitoring around schools, childcare facilities, healthcare facilities, and residences.
18. Research into future wireless technologies before widespread deployment rather than relying primarily on post-deployment surveillance.
19. Development of publicly accessible exposure information for consumers and communities.
20. Establishment of a coordinated federal RF/EMF research program involving HHS, NIH, CDC, FDA, and other relevant federal agencies.

Conclusion

I appreciate HHS for requesting public and professional input on this subject.

After years of working directly with thousands of people and evaluating electromagnetic environments in homes and other buildings, I believe the question of RF/EMF exposure and human health deserves substantially more rigorous attention than it has historically received in the United States.

My position is not that every symptom attributed to EMF is caused by EMF.

My position is that the scientific evidence is sufficiently complex, the exposure is sufficiently widespread, the biological questions are sufficiently important, and the number of people reporting adverse effects is sufficiently large that additional independent research is warranted.

There is evidence of biological activity in experimental systems. There are concerning findings in some animal studies. There are human epidemiological studies with varying results and substantial uncertainty. There are systematic reviews showing important research gaps. There are also systematic reviews that have not demonstrated consistent effects for several outcomes.

All of those facts should be considered.

The appropriate scientific response to this combination of evidence is not to declare the matter settled in either direction.

It is to conduct better research.

Federal research should reflect the exposure conditions people actually experience today: multiple simultaneous wireless sources, varying frequencies, modulation and pulsing, prolonged duration, close-body exposure, nighttime exposure, and cumulative exposure over years.

It should also investigate potentially sensitive populations rather than excluding them from meaningful research simply because current scientific models do not adequately explain their experiences.

Most importantly, the research should be independent, transparent, reproducible, and designed to distinguish between correlation, causation, susceptibility, and biological mechanism.

I respectfully encourage HHS to use this RFI as an opportunity to establish a comprehensive, independent, long-term federal research program on RF/EMF exposure and human health.

The public deserves neither unnecessary alarm nor premature reassurance.

The public deserves high-quality science, accurate exposure information, transparent communication of uncertainty, and the ability to make informed decisions about the environments in which they and their families live.

Supporting Scientific References

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