PUBLIC COMMENT

Request for Information on Electromagnetic Fields (EMFs), Radiofrequency (RF) Radiation, and Wireless Radiation Exposure

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Executive Summary

This comment responds to the HHS Request for Information on EMF/RF radiation and human health (91 FR 59792). We address Questions 5–06, 8–13, 14–16, and 18 from the perspective of the Progressive Evidence Model (PEM), a multi-domain analytical framework developed by NeuroEthics Research Lab that integrates biophysical exposure analysis and neurofunctional integrity assessment across five physical domains: radiofrequency/directed energy, acoustic/infrasonic, ionizing radiation, spectral interference, and static/ELF magnetic fields.

Our contribution is grounded in peer-reviewed and preprint research, including publications in Elsevier (forthcoming, 2027), SSRN working papers, and an original six-layer taxonomy for cognitive warfare analysis. We identify three critical gaps that this RFI should address: (1) the absence of multi-domain exposure assessment methodologies that account for simultaneous, cumulative, and synergistic effects across physical vectors; (2) the regulatory blind spot at the intersection of telecommunications infrastructure and neurofunctional impact; and (3) the lack of instruments for quantifying sub-clinical neurofunctional degradation from chronic RF/EMF exposure.

Questions 5–6: Exposure Standards and Risk Assessment

The multi-domain gap. Current exposure standards—including FCC limits based on thermal effects and ICNIRP guidelines—evaluate RF exposure in isolation from other physical vectors. Our research demonstrates that real-world exposure environments involve simultaneous radiofrequency, acoustic/infrasonic, and magnetic field exposures whose biological effects are non-additive. Our multi-spectral convergence analysis documents five peer-reviewed studies confirming synergistic interactions: combined microwave and electromagnetic pulse exposure produces hippocampal ferroptosis absent in

single-vector exposure; ELF magnetic fields combined with infrasonic vibration produce cellular effects absent in either stimulus alone.

Sub-thermal bioeffects. The foundational work of Bawin and Adey (1976, 1978, PNAS) and Blackman et al. (1979, Radio Science) established that RF fields at intensities well below thermal thresholds alter calcium ion efflux from neural tissue—a finding with direct implications for voltage-gated calcium channel (VGCC) function and downstream neuroimmune cascades. These findings, now nearly five decades old, remain inadequately reflected in exposure standards that continue to rely primarily on thermal dose models.

High-power microwave (HPM) and high-energy laser (HEL) bioeffects. Beyond chronic low-level exposure, the RF/EMF spectrum includes high-power pulsed sources with documented acute bioeffects that current civilian health frameworks do not address. HPM sources produce the microwave auditory effect (Frey effect)—perception of clicks and buzzing from pulsed microwave absorption in cranial tissue—as well as blood-brain barrier disruption at power densities below thermal damage thresholds. Nanosecond electrical pulses (nsEP) generate mechanical pressure transients in biological tissue (Roth et al., 2016), a mechanism distinct from thermal absorption. HEL systems produce retinal and dermal injury at distances where no thermal sensation precedes tissue damage. These effects occupy the same electromagnetic spectrum as commercial telecommunications and industrial RF sources; the distinction between 'weapon' and 'emitter' is one of intent and power level, not of physics. HHS risk assessment should therefore evaluate the full continuum of RF/EMF exposure intensity—from chronic sub-thermal to acute high-power—rather than treating military-grade directed energy and civilian RF as categorically separate domains.

Recommendation: HHS should commission the development of multi-domain exposure assessment protocols that evaluate cumulative and synergistic effects across RF, acoustic, and magnetic field vectors simultaneously, across the full intensity continuum from chronic sub-thermal to acute high-power microwave exposure. Current single-vector, thermal-only standards are necessary but insufficient to characterize real-world exposure risk.

Question 8: Improvements in Exposure Assessment Methodologies

Existing exposure assessment relies predominantly on single-frequency, single-domain measurement (e.g., SAR for RF, dBA for acoustic). We propose a multi-domain forensic measurement architecture covering five physical domains:

- **RF/Directed Energy:** broadband spectral monitoring across VHF through Ka-band (30 MHz–40 GHz), including pulsed emission detection and rate-of-change anomaly classification.
- **Acoustic/Infrasonic:** measurement below 20 Hz where organ resonance frequencies (7–19 Hz) interact with vagal nerve function and gastrointestinal motility.
- **Static/ELF Magnetic Fields:** DC and sub-30 Hz magnetic field measurement currently absent from all commercial EMF monitoring equipment—a critical instrumentation blind spot.
- **Ionizing Radiation:** environmental dosimetry for baseline exclusion.

- **Spectral Interference:** cross-domain temporal correlation to identify synchronized multi-vector exposure patterns.

This architecture addresses a fundamental gap: no currently deployed measurement system captures cross-domain temporal correlation. Our empirical measurements demonstrate synchronized multi-band activation patterns across VHF, ISM, Band S, Band C, and Band X within two-minute windows—patterns invisible to single-domain instruments.

Recommendation: Federal agencies should fund development of integrated multi-domain exposure monitoring platforms and establish standardized protocols for cross-domain temporal correlation analysis. The instrumentation gap in the DC/ELF magnetic field range (<30 Hz) is particularly urgent given documented bioeffects at these frequencies.

Question 9: Technical and Exposure Information Disclosure

The disclosure gap is architectural, not informational. Current disclosure frameworks focus on device-level specifications (SAR values, power output, signal strength). Our research demonstrates that the relevant disclosure unit is not the individual device but the cumulative exposure architecture that emerges from device integration within an occupied space.

Our research establishes that a standard residential dwelling equipped with commercial technology constitutes a multi-domain exposure environment operating through simultaneous RF, magnetic field, and acoustic channels—none of which is disclosed to occupants. We identify five disclosure categories currently absent from regulatory requirements: cumulative RF power density per space, sub-audible acoustic emission profiles, DC/ELF magnetic field baselines, physiological sensing capabilities of installed equipment, and temporal exposure dynamics across 24-hour cycles.

Recommendation: Disclosure requirements should extend beyond device-level SAR to encompass cumulative environmental exposure architecture. Consumers and building occupants should receive standardized multi-domain exposure profiles for their environments. The current inability of consumers to independently measure DC/ELF magnetic fields—due to instrumentation unavailability—makes mandatory institutional disclosure in this range particularly urgent.

Question 10: Data Sources and Surveillance Systems

From dosimetric surveillance to neurofunctional monitoring. Existing surveillance systems for RF/EMF health effects—where they exist at all—rely on dose tracking and disease registry correlation. Our research demonstrates that a fundamentally different surveillance architecture is needed: one that monitors neurofunctional integrity longitudinally, independently of diagnosed pathology.

We have developed instruments that address six surveillance modalities: disease registries augmented with intermediate clinical presentations that precede registrable pathology (sentinel indicators such as dysautonomia, vestibular dysfunction, and cognitive fog); occupational monitoring extended with autonomic nervous system scoring to detect sub-clinical degradation before symptomatic presentation; environmental monitoring expanded to include the DC/ELF magnetic field range and infrasonic emission; longitudinal cohorts built on standardized neurofunctional baselines rather than dose tracking alone;

biomonitoring using specific markers for chronic sub-thermal exposure (HRV, calprotectin, zonulin, butyrate, microbiome diversity); and structured adverse event reporting with multi-domain exposure fields and chain-of-custody integrity.

Recommendation: Federal surveillance architecture should evolve from dose tracking to neurofunctional monitoring. Specifically: establish a national EMF adverse event reporting system with structured multi-domain exposure fields; fund longitudinal cohorts with standardized neurofunctional baselines; expand environmental monitoring to include DC/ELF magnetic fields and infrasonic emission; and develop occupational neurofunctional screening protocols for RF-exposed workers, analogous to existing audiometric requirements for noise-exposed workers.

Question 11: Sensitive Populations

Current risk evaluation frameworks for sensitive populations focus on dose reduction (e.g., lower SAR limits for children). While necessary, this approach misses a more fundamental question: differential neurofunctional vulnerability. We have developed instruments that address this gap:

- **Autonomic dysregulation profiling:** a multi-component scoring system that quantifies autonomic nervous system disruption across neurochemical, vestibular, and vagal dimensions. This instrument captures sub-clinical dysregulation that precedes symptomatic presentation.
- **Neurofunctional baseline assessment:** a multi-domain evaluation integrating neurocognitive, neurophysiological, immunological, metabolic, and behavioral markers. Designed to establish individual baselines against which exposure-correlated changes can be measured longitudinally.

These instruments enable what current frameworks cannot: the identification of individuals whose neurofunctional baseline makes them differentially susceptible to RF/EMF exposure, and the longitudinal tracking of sub-clinical degradation before it manifests as diagnosable pathology.

Recommendation: Risk evaluation for sensitive populations should incorporate neurofunctional baseline assessment and longitudinal monitoring. The relevant question is not only whether a population receives a higher dose, but whether specific neurofunctional profiles amplify biological response to exposure at any dose level.

Questions 12–13: Existing Evidence and Cumulative Exposure

The brain as network endpoint. Our analytical framework establishes that modern telecommunications infrastructure does not merely transport data about users—it creates bidirectional pathways where the human brain functions as a de facto network endpoint. This proposition rests on three empirically documented capabilities:

First, Wi-Fi Channel State Information (CSI) research has demonstrated that standard 802.11 signals can detect human respiration rate, heart rate, gait patterns, and even emotional states through walls, without any device on the subject's body—the human body modulates the RF channel, and the infrastructure reads that modulation. Second, wearable and near-body devices (smartwatches, earbuds, smart rings) equipped with PPG, EEG-adjacent, and galvanic skin response sensors transmit continuous physiological telemetry to cloud infrastructure, creating a real-time neurophysiological data stream. Third, smart

speakers and IoT hubs with ultrasonic and infrasonic emission capabilities operate below and above audible thresholds, interacting with biological tissue in ways that current acoustic exposure standards do not capture.

The cumulative effect is architectural: the technologies listed in Question 13 (5G, Wi-Fi, IoT, wearables, smart homes, autonomous vehicles, wireless medical devices) do not simply expose the user to additive RF power—they create an integrated sensing and emission environment where the human nervous system is simultaneously a target of multi-domain energy exposure and a source of extractable physiological data. This bidirectionality—exposure to and extraction from—is what distinguishes the current technological environment from any historical precedent and what makes cumulative exposure assessment fundamentally more complex than power-density summation.

The residential environment as exposure system. A companion analysis demonstrates that a residential dwelling equipped with standard commercial technology (Wi-Fi routers, smart speakers, IoT hubs) can function as an integrated multi-domain exposure environment operating through RF reflectometry (Wi-Fi CSI encoding physiological data), remote magnetic fields (DC/ELF sensing via magnetometer-equipped devices), and acoustic transduction (infrasonic and ultrasonic emission via embedded speakers)—creating cumulative effects that no single-device assessment captures. The dwelling becomes, in functional terms, an unregulated environmental interface with the occupant's nervous system.

The regulatory blind spot. Telecommunications regulation governs spectrum allocation and power output. Health regulation governs dose limits. No regulatory framework currently addresses the transition point where a communication signal becomes a physiological stimulus. This gap is not marginal—it is structural, and the technologies in Question 13 widen it with each deployment cycle.

The sociotechnological exposome framework, detailed in our forthcoming Elsevier chapter (Correa Arechavala, 2027, Vol. 10 Neuroethics & Bioethics, eds. Cabrera & Illes), proposes that cumulative RF/EMF exposure cannot be assessed without accounting for digital cognitive load, social isolation dynamics, and environmental amplifiers—a departure from purely dosimetric approaches.

Recommendation: HHS should evaluate cumulative exposure not only by summing power densities across devices, but by assessing the architectural integration of these technologies and their collective neurofunctional impact. Regulatory frameworks need to address the communication-to-stimulus transition explicitly.

Question 14: Evidence for Adverse Environmental Effects of RF Radiation

Cross-species relevance of sub-thermal mechanisms. The sub-thermal bioeffects documented since Bawin and Adey (1976)—calcium ion efflux from neural tissue at RF intensities below thermal thresholds—are not species-specific. Voltage-gated calcium channels (VGCCs) are evolutionarily conserved across vertebrates, and the calcium signaling pathways disrupted by sub-thermal RF exposure are fundamental to neurological function in birds, insects, amphibians, and marine organisms.

Our research identifies three environmental mechanisms with direct cross-species relevance: navigational disruption via DC/ELF magnetic field interference with magnetoreception systems in migratory species; pollinator disruption through RF-mediated calcium signaling interference in honeybee neural tissue,

compounded by multi-vector synergistic effects documented in the literature; and aquatic ecosystem disruption via infrasonic and ELF propagation through water—an efficient medium for both—affecting cetacean and fish species that rely on low-frequency cues for navigation and reproduction.

The sociotechnological exposome framework extends to ecosystems: satellite constellation downlinks (Ku/Ka-band), smart agriculture RF, and submarine telecommunications cables introduce exposure vectors into natural habitats with no historical precedent and no existing environmental monitoring framework to capture their multi-domain character.

Recommendation: Environmental impact assessment for RF infrastructure should incorporate sub-thermal bioeffect mechanisms (VGCC-mediated calcium disruption) as endpoints, multi-vector cumulative exposure modeling for pollinator and migratory species habitats, DC/ELF magnetic field monitoring in ecologically sensitive areas, and aquatic environment assessment near submarine cable routes and offshore energy installations.

Question 15: Evidence on Wireless Infrastructure Proximity

From power density to architectural exposure. The conventional framing of wireless infrastructure risk focuses on power density as a function of distance. Our research demonstrates that this framing fundamentally underestimates the exposure impact of infrastructure proximity because it ignores three critical factors.

First, multi-vector co-location: wireless infrastructure does not emit only in its licensed band. A 5G small cell co-located with Wi-Fi access points, IoT gateways, and smart city sensors creates a multi-vector environment where RF, acoustic, and magnetic field emissions overlap. Peer-reviewed research documents synergistic biological effects from combined vectors that are qualitatively different from single-vector exposure. Infrastructure assessments measuring only primary RF emission systematically undercount actual exposure.

Second, the dwelling as exposure amplifier: residential proximity to infrastructure converts the dwelling itself into an amplifier through RF standing wave patterns from interior reflections, structural coupling with ELF magnetic fields via building materials (rebar, ductwork, plumbing), and acoustic propagation of infrasonic vibration through building structures at organ-resonance frequencies (7–19 Hz).

Third, small-cell multiplication: the transition from macro-cell to small-cell architecture reduces per-antenna power but increases antenna density and proximity to occupied spaces. Our instrumental monitoring demonstrates that the relevant metric in dense deployments is not individual antenna output but aggregate temporal exposure patterns—including synchronized emissions and multi-band activation that emerge from dense co-located infrastructure.

Recommendation: Wireless infrastructure proximity assessment should evolve from single-frequency power density modeling to multi-vector cumulative exposure profiling. Require multi-domain assessments (RF + acoustic + magnetic) for new infrastructure within 200 meters of schools, healthcare facilities, and residential areas; account for dwelling-amplification effects; establish cumulative metrics for dense small-cell deployments; and fund proximity studies measuring neurofunctional endpoints rather than dose alone.

Question 16: Federal Research Priorities

Our Cognitive Warfare Layered Architecture (CWLA; Correa Arechavala, 2026, SSRN Abstract ID 7356479), a six-layer analytical taxonomy, maps 11 existing frameworks and reveals that the overwhelming majority of research, including NATO cognitive warfare doctrine, addresses the informational, social, and institutional layers while the physical/biophysical and neurocognitive layers remain critically underresearched. This imbalance has direct consequences for the questions posed in this RFI: the health effects of RF/EMF exposure sit precisely at these underresearched layers, where the evidence base is thinnest and the need for federal research investment is greatest.

Priority research gaps include:

- **Multi-vector synergy quantification:** controlled studies of combined RF + infrasonic + magnetic field exposure at sub-threshold intensities, measuring non-additive biological effects.
- **Chronic low-level exposure biomarkers:** longitudinal identification of biomarkers (HRV, fecal calprotectin, zonulin, butyrate, microbiome diversity) that track sub-clinical degradation trajectories from chronic RF/EMF exposure.
- **Neurofunctional integrity metrics:** development of standardized instruments for quantifying neurofunctional status independent of diagnosed pathology—analogous to how HbA1c tracks glycemic control independent of diabetes diagnosis.
- **Instrumentation for the DC/ELF gap:** commercial and research-grade instruments that cover the 0–30 Hz magnetic field range, currently absent from the market.

Recommendation: NIH and NIEHS should prioritize research at the physical/biophysical layer, focusing on multi-vector synergistic effects and chronic sub-threshold exposure. This is where the evidence gap is widest and the public health implications most direct.

Question 18: Additional Information

Federal health agencies should be aware of several recent international developments that bear directly on this RFI:

- **UN Human Rights Advisory Committee Report A/HRC/60/63 (July 2025):** formally recognizes directed energy weapons (lasers, microwaves, millimeter waves, particle beams) as a human rights threat, noting they 'provoke intense pain by heating bodily fluids.' Paragraph 36 states that neurotechnologies 'could constitute torture, even in the absence of physical violence.'
- **UN Special Rapporteur on Torture, Report A/HRC/43/49 (Nils Melzer, 2020):** formally defines 'contactless torture' and 'cyber-torture,' identifying remote technological devices as means of inflicting severe suffering without physical proximity.
- **UN Special Rapporteur on Privacy, Report A/HRC/58/58 (January 2025):** establishes the precautionary principle: where there is a possibility of serious and irreversible harm, protective measures are mandatory even without causal certainty. This has direct implications for RF/EMF regulation.

- **NATO STO-MP-SCI-356 (Panel 5):** technical documentation of directed energy bioeffects capabilities within military frameworks.
- **UNIDIR Innovations Dialogue 2026 — "Electromagnetic Disruption, Peace and Security" (11 November 2026, Geneva):** the United Nations' flagship security innovations dialogue dedicates its 2026 edition to the electromagnetic spectrum as a domain of strategic competition. Panel 4 addresses "Arms control and disarmament in the age of electromagnetic spectrum disruptions." The official framing recognises that "disruptions affect not only military operations but also civilian services and critical infrastructure."

The convergence of three independent UN bodies (Advisory Committee, Special Rapporteur on Torture, Special Rapporteur on Privacy) on the recognition of directed energy and neurotechnology as human rights threats between 2020 and 2025, together with UNIDIR's 2026 decision to frame the electromagnetic spectrum as a strategic domain affecting civilian infrastructure, constitutes a normative trajectory that HHS should consider alongside its domestic scientific review.

Recommendation: HHS should incorporate these international normative frameworks into its assessment, particularly the precautionary principle articulated in A/HRC/58/58, and coordinate with the State Department's existing work on Anomalous Health Incidents (AHI), which addresses overlapping RF/EMF bioeffect concerns.

References

[1] Correa Arechavala, H.A. (2026). Beyond Narratives: A Six-Layer Architecture for Full-Spectrum Cognitive Warfare Analysis. SSRN Abstract ID 7356479.

[2] Correa Arechavala, H.A. (2027, forthcoming). From Environmental Exposome to Sociotechnological Exposome: A Progressive Evidence Approach to Neurofunctional Integrity. In L. Cabrera & J. Illes (Eds.), Vol. 10 Neuroethics & Bioethics. Elsevier/Academic Press.

[3] Correa Arechavala, H.A. (2026). The Progressive Evidence Model (PEM). SSRN Abstract ID 6403298.

[4] Correa Arechavala, H.A. (2026). From Watchlisting to Neurofunctional Inference: The Evolution of Data-Mediated Intervention. SSRN Abstract ID 7287158.

[5] Correa Arechavala, H.A. (2026). Convergence Without Consent: The Regulatory Emergency at the Intersection of Human Digital Twins, Neurocognitive Capture Architectures, and Cognitive Superiority Doctrines. SSRN Abstract ID 7235559.

[6] Bawin, S.M. & Adey, W.R. (1976). Sensitivity of calcium binding in cerebral tissue to weak environmental electric fields oscillating at low frequency. PNAS, 73(6), 1999–2003.

[7] Bawin, S.M., Adey, W.R. & Sabbot, I.M. (1978). Ionic factors in release of $^{45}Ca^{2+}$ from chicken cerebral tissue by electromagnetic fields. PNAS, 75(12), 6314–6318.

[8] Blackman, C.F. et al. (1979). Induction of calcium-ion efflux from brain tissue by radio-frequency radiation. Radio Science, 14(6S), 93–98.

[9] Roth, C.C. et al. (2016). Characterization of Pressure Transients Generated by Nanosecond Electrical Pulse (nsEP) Exposure. PLOS ONE, 11(4), e0154555. DOI: 10.1371/journal.pone.0154555.

[10] UN Human Rights Council (2020). Report of the Special Rapporteur on torture and other cruel, inhuman or degrading treatment or punishment. A/HRC/43/49.

[11] UN Human Rights Advisory Committee (2025). Impact of new and emerging technologies on the promotion and protection of human rights. A/HRC/60/63.

[12] UN Human Rights Council (2025). Report of the Special Rapporteur on the right to privacy. A/HRC/58/58.

[13] Camargo Brito, R. & Cuevas Valenzuela, H. (2026). La prueba neurocientífica en la práctica judicial chilena. Rev. Chilena de Derecho y Ciencia Política, 17(1), 1–33. DOI: 10.7770/rchdcp-v17n1-art530.

[14] Pall, M.L. (2018). Wi-Fi is an important threat to human health. Environmental Research, 164, 405–416. DOI: 10.1016/j.envres.2018.01.035.

[15] Balmori, A. (2015). Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation. Science of the Total Environment, 518–519, 58–60. DOI: 10.1016/j.scitotenv.2015.02.077.

[16] Favre, D. (2011). Mobile phone-induced honeybee worker piping. Apidologie, 42(3), 270–279. DOI: 10.1007/s13592-011-0016-x.

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