Section 6

What the Limits Assume and What the Public Is Told: The Assumptions Behind Current Exposure Assessment, and Electromagnetic Literacy Without Fear

Author: J. Joaquín Machado, EMR Researcher and EFEIA Founder & Director. **EFEIA Institute**, Miami, Florida, USA. info@efeia.org. **Evidence grades:** (a) peer-reviewed, standards body, court or regulatory record, or accredited laboratory report; (b) institutional report, agency guidance, preprint, thesis or recognized seal; (c) manufacturer, advocacy or media source.

Scope: the assumptions behind the FCC, ICNIRP and IEEE radiofrequency limits and the assessment practices built on them, including device testing, workers and pregnancy, and how exposure is explained to the public, schools, clinicians and workers. **RFI questions answered:** 3(b), 4(l), 5 and 5(n) to 5(p), 6, 8, 9 (consumers, schools, healthcare providers, workers, local governments), 10(b), 10(d), 10(h), 11(a), 11(b), 11(e), 12, 13(a), 13(c), 13(f), 13(k), 15(a), 16 and 17, tagged in brackets where answered.

OUR PROPOSAL

EFEIA proposes that HHS review, one by one, the assumptions on which the FCC and ICNIRP exposure limits rest, starting with the fourteen identified by ICBE-EMF and set out in J. Joaquín Machado's Electromagnetic Pollution book, state which of them current evidence still supports, and send that assessment to the FCC for the remand record.

Where an assumption does not hold, the test or limit built on it should change: device testing at body contact and with child and pregnant anatomical models, limits for brief pulses, assessment of combined exposures, and protection for workers and pregnant women.

To carry this into practice, EFEIA proposes a four-stage National Program for Scientific Integration and Professional Education on Electromagnetic Exposure and Health, convened by HHS: evidence synthesis, consensus review of the assessment criteria, university and continuing education, and public guidance tested for comprehension and effects on anxiety before release, so that it builds competence without fear (Exhibit 6A).

1 SUMMARY OF THE ISSUE

1. The limits rest on heating. The U.S. limits (47 CFR 1.1310, adopted in 1996) and ICNIRP 2020 and IEEE C95.1-2019 are designed to prevent tissue heating and, at low frequencies, nerve stimulation [1-3]. They derive from 1980s studies in which 5 monkeys and 8 rats were exposed for 40 to 60 minutes: an apparent threshold of 4 W/kg was divided by 10 for workers (0.4 W/kg) and by a further 5 for the public (0.08 W/kg) [4]. In a peer-reviewed commentary, ICBE-EMF identifies fourteen assumptions behind them and cites evidence against each [4]; Machado's Electromagnetic Pollution sets them out for practitioners [5] (Table 1).

2. What the public is told. Federal information is thin: EPA and NCI each give four tips and point to the existing limits [6,7]. Yet use changes dose: on 2G phones, exposure was up to four orders of magnitude higher under weak than strong reception, up to 90% lower at 16 cm than 4 cm from the ear, and 10-400 times lower from a Bluetooth headset [8]. EFEIA found no evaluation of any U.S. exposure message for comprehension, behavior or anxiety, and no curriculum for schools or clinicians. Fear is a design risk: an alarming television report raised symptom reports after sham Wi-Fi exposure among anxious viewers [9], while precautionary text worded as health authorities word it did not [10].

Compliance is not protection. The FCC rule allows short exposures above the limit if the average holds [1]; pulse peaks, modulation, polarization, simultaneous sources and a phone beside the bed all night go unmeasured. HHS's National Toxicology Program found clear evidence of malignant heart schwannomas in male rats exposed at 1.5 to 6 W/kg [11], rated high certainty in a WHO-commissioned review [12]. Saying that devices meet FCC limits answers a heating question.

[Q17(b), Q17(c)] Bottom line. The 1996 limits rest "primarily on the recommendations" of EPA, FDA and

other federal health agencies [13], so HHS's view carries into the remanded rule [14,15]. EFEIA asks HHS to state, for each assumption, whether current evidence supports it (P2), and to convene a four-stage national program that carries the result into assessment criteria, professional education and tested public information [16] (P8, Table 4).

2 WHY IT MATTERS

Use has moved onto the body. The D.C. Circuit asked the FCC for "a reasoned explanation" that its guidelines protect against harms "unrelated to cancer" [14]. In ANFR test data for 450 phones, SAR falls 10% to 30% per millimeter, so most phones held against the body would exceed the ICNIRP limit 1.6 to 3.7 times, or the FCC 1 g limit up to 11 times [17].

[Q3(b), Q5, Q11(a)] **Advice and practice diverge.** California advises keeping the phone away from the bed at night [18]; in EFEIA's Census, 43.8% of 283 respondents did not switch the phone off at bedtime and 63.9% checked it at night with the lights off at least sometimes [19]. Parents hear that children can be more exposed than adults in certain bands [20], to keep the phone out of pockets [21], and from federal agencies mainly that devices comply [6,7]. In an eight-country sample of 3,097, phone masts on a school roof were rated the riskiest source, although phones dominate personal exposure [22].

3 CURRENT LIMITATION OR GAP [Q5(o), Q5(p)]

[Q6] **Table 1.** The fourteen assumptions identified by ICBE-EMF [4], condensed, with two from [5] (A, B). Evidence as cited and printed in [4], grade (a), peer-reviewed comment.

#	Assumption	Evidence ICBE-EMF cites against it	Other assessment (grade)
1	Adverse effects require whole-body SAR above 4 W/kg and are due to heating	NTP: heart schwannomas and gliomas at 1.5-6 W/kg, body temperature up no more than 1 °C; Ramazzini: heart schwannomas at 50 V/m, about 0.1 W/kg	High certainty for these increases in male rats [12] (a)
2	RF cannot damage DNA except by heating	Oxidative effects in 93 of 100 low-intensity studies; DNA strand breaks in rat testes at 0.166-0.174 W/kg	No consistent evidence [23] (b)
3	Two to seven exposures of up to 1 hour exclude effects of any duration	14 or 16 weeks at 2,450 MHz changed rat behavior at 0.7 and 1.23 W/kg	None cited
4	Co-exposure adds no effect	IARC: 4 of 6 co-carcinogenesis studies positive; more tumors in carcinogen-treated mice at 0.04-2 W/kg	Section 3
5	Only time-averaged SAR matters	A GSM pulse can be 8 times the continuous-wave exposure at equal average SAR	No pulsed-continuous difference [2] (a)
6	Tumor studies are biased; brain cancer rates are steady	Longest use: glioma OR 1.90 (1.31-2.76). SEER 2000-2018: glioblastoma up 0.3% a year	Moderate certainty of no increase [24] (a)
7, 8	Individuals, including children, do not differ in absorption or sensitivity	Peak SAR about 2-fold higher in children's brains and 10-fold in skull marrow; ICNIRP 2002 noted lower tolerance in some groups	Child whole-body SAR up to 40% above adult [2] (a); provocation studies null [25] (a)
9, 10	Safety factors of 50 (public) and 10 (workers) protect	Usual practice would need about 900 to 10,000; benchmark-dose modeling puts 0.08 W/kg 20 to 40 times above protective values	ICNIRP 2020 keeps both [2] (a)
11, 12	Local SAR of 1.6 (1 g) or 2 W/kg (10 g), 8 or 10 W/kg for workers, adds no risk	A 10 g cube underestimates peak SAR about 2.5-fold at 2.45 GHz and 16-fold at 5.8 GHz against smaller cubes	ICNIRP 2020 keeps 2 W/kg [2] (a)
13	No concern for wildlife	Garden warblers disoriented at 2-3 nT; GSM reduced egg laying by queen bees	Section 5
14	5G needs no health data: absorption is superficial	At 26 GHz more than 86% of power is absorbed in the first millimeter of skin	Limits above 6 GHz set [2] (a)
A, B	Only tissue damage counts; negative provocation studies show harmlessness	NTP: no tissue damage at 28 days at SARs that produced tumors over two years; provocation designs ignore onset, washout and individual triggers	EEG changes below 2 W/kg set aside [2]; 41 studies null [25] (a)

G1. Only heating counts. ICNIRP notes EEG changes below 2 W/kg "but there is no evidence that these relate to adverse health effects" [2]. **G2. Averaging hides peaks.** The FCC averages over up to 30 minutes and has no brief-pulse limit, which ICNIRP 2020 and IEEE C95.1-2019 added [1-3,26]. **G3. Modulation set aside:** 900 MHz pulsed at 14 Hz increased sleep-spindle EEG power in 30 men [27]. **G4. Polarization** is a dosimetric variable

only [28]. **G5. Combined exposure** is summed only for heating and stimulation [2]. [Q11(a)] **G6. Tests differ from use:** device limits apply within 20 cm [1], while phones sit in pockets and against the ear [17]. [Q9, Q10(b), Q11(e)] **G7. Workers:** OSHA has no specific RF standard [29,30], and no federal registry of occupational exposure exists; Directive 2013/35/EU requires risk assessment, including workers with implants and pregnant workers, and worker information on transient sensory effects [31]. [Q11(b)] **G8. Pregnancy:** ICNIRP treats a pregnant worker and the fetus as members of the public; the FCC rule does not mention pregnancy [1,2]; fetal SAR has been modeled below maternal SAR for plane waves [32].

[Q9] **G9. Messages without evaluation.** None of the EPA, NCI or California messages has a published evaluation [6,7,18]; of a UK leaflet printed in about 9 million copies, 15% of a national sample reported having seen it [33]. [Q5] **G10. Compliance framing.** No federal page explains what the limits leave out; Germany's office states that uncertainties remain and recommends reducing exposure as a precaution [34]. [Q5(o)] **G11. Wording untested in the United States:** explaining how much distance reduces exposure raised conditional risk perception in an Australian trial [35]. [Q9] **G12. No professional education:** ANSES asked for training of health professionals to receive people reporting EHS [36], and WHO for balanced information to clinicians and employers [37]; EFEIA found no U.S. guidance, and no program linking engineering, exposure science, biology, medicine and public health [16]. [Q9, Q13(c), Q15(a)] **G13. Schools and points of sale:** EFEIA found no U.S. federal guidance for schools; Berkeley's point-of-sale notice survived a preliminary-injunction challenge as "literally true" [38], and local governments need wording tested for comprehension and antenna site information (Section 2).

4 EXISTING EVIDENCE [Q5, Q10(d), Q12]

F1. For heating, the framework is well supported, and ICNIRP and IEEE amended it for brief pulses; the FCC has not [1-3]. **F2. Whether heating suffices is contested.** NTP TR-595 (900 MHz, 1.5-6 W/kg, about 9 hours a day for 2 years) found clear evidence of heart schwannoma in male rats and some for glioma, at exposures "much greater than what people experience" [11]; Ramazzini (1.8 GHz, 0.001-0.1 W/kg, 19 hours a day) found heart schwannomas in males at 50 V/m [39]; human data on adult phone use show no increase in brain cancer with moderate certainty [24]; IARC classified RF-EMF as Group 2B in 2011 [40]. [Q6] **F3. At the current limits:** phones held against the body would exceed them (Part 2) [17], and the Ramazzini range spans the 0.08 W/kg public limit [12,39]. [Q13(f)] **F4. Wearables:** a UMTS smartwatch reached 2.15 W/kg, 108% of the 2 W/kg head and trunk limit, on its display side [41]. [Q13(k)] **F5. Smart meters:** duty cycles of about 0.22% or less in 99.5% of almost 47,000 California meters [42], with up to 20 V/m at 50 cm during transmission [43]. **F6. Assumed exposure has not been compared with actual exposure:** EFEIA knows no U.S. survey of peaks, duty cycles, polarization or combined exposure in homes or bedrooms.

Table 2. Communication and nocebo evidence. Values as printed in each source.

Topic	Source (grade)	Result as reported
Media warnings	Witthöft 2013, Verrender 2018 (a) [9,44]	A television report raised EMF worry and, among viewers with high anxiety, symptoms and attribution after 15 min of sham Wi-Fi (n = 147). An alarmist video raised symptoms, anxiety and risk perception (22 per arm)
Precautionary advice	Boehmert 2018, 2016 (a) [10,35]	A translated BfS text on Wi-Fi: no main effect on symptoms after sham exposure (n = 137); prior risk perception predicted nocebo responses. Amplification not replicated in 1,717 Australians; explaining precaution effectiveness raised conditional risk perception (d = 0.33)
Measurement in education	WHO 2002 (b) [45]	Fields are invisible and exposure beyond immediate control; WHO advises showing field measurement data to the public

5 WHAT EFEIA CAN CONTRIBUTE [Q4(l), Q9]

Table 3. EFEIA datasets and actions. The program design is Exhibit 6A.

Dataset or action	Gap	Contribution
Evidence register	Table 1	Studies for and against each assumption, as a starting point for the review in P2 [4,5]
Planned field datasets	G2-G6	Sub-second peaks for Wi-Fi, LTE/5G and smart meters in bedrooms; modulation; triaxial polarization; co-located 50/60 Hz, 2-150 kHz and RF; fields at 0 mm and child distances; metadata following IEEE C95.3-2021 [46]
Habits with dose basis	G9, G11	EFEIA's electromagnetic hygiene habits, each tagged "dose reduction measured", with its source, or "not established"; only the first are presented as effective
LEDNA principle	G9, G13	Design and distance before blocking, for homes, schools and workplaces, starting with sleep spaces [47]

Training and Census module	G12, R9	GEMS Academy's practitioner program, for which EFEIA supplies documents (NOXTAK ecosystem); knowledge, information-source and validated anxiety items in the next Census wave
National Program design	G12, G13	Four stages with reviewable outputs (Table 4) [16]; the items above as inputs

EFEIA data describe exposure; they are not evidence of health effects. Materials produced by EFEIA or NOXTAK are labeled as such, with the relationship stated (Section 5), and reviewed by an independent risk-communication specialist before any federal use.

6 ADDITIONAL RESEARCH NEEDED [Q5(o), Q8, Q16]

R1. Assumption-by-assumption review by reviewers without conflicting interests, starting from the WHO-commissioned reviews [12,24]. **R2. NTP replication:** the Japan-Korea replication ICNIRP reports should publish dosimetry, temperature and pathology in full [11,48]. **R3. Modulation at fixed dose,** with preregistered endpoints including sleep EEG [27]. **R4. Peaks, polarization and combined exposure** measured and tested together [26,28,48]. **R5. Children and body contact:** SAR at 0 mm and in child models for current devices [17]. [Q5(o), Q9] **R6. U.S. message-framing trial:** current federal text against a competence-framed text and an alarm-framed clip, with knowledge, risk perception, behavior, anxiety and a sham-exposure sub-study [9,10,35]. [Q8, Q13(a), Q13(c), Q13(f)] **R7. Dose of taught behaviors on current networks:** the California measurements repeated for LTE, 5G NR, Wi-Fi and wearables worn overnight [8]. [Q9, Q11(a)] **R8. School module (Stage 4):** cluster-randomized, built on environmental health literacy as NIEHS authors frame it, with teacher and parent components and results by socioeconomic group [49]. [Q10(h), Q17(c)] **R9. National baseline:** a National Health Interview Survey module on bedside phone use, overnight transmission and the age at which children receive devices, replacing self-selected baselines such as EFEIA's Census [19]. [Q9] **R10. Disclosure comprehension** for point-of-sale and in-device notices; the Ninth Circuit noted no evidence of how consumers understood Berkeley's notice [38].

7 PROPOSAL AND NEXT STEPS [Q5(n), Q16, Q17]

P1. EFEIA comments in ET Docket 13-84 by 21 October 2026 on body-contact testing, children and brief pulses [15]. [Q17(a), Q17(b)] **P2.** HHS, through FDA CDRH and NIEHS, gives the FCC an updated review of endpoints unrelated to cancer, drawing on the WHO-commissioned reviews and NTP TR-595, and states for each assumption in Table 1 whether current evidence supports it, does not, or leaves it open [11,12,14,24]. **P3.** The FCC adopts brief-interval and single-pulse limits at least equivalent to ICNIRP 2020 and IEEE C95.1-2019 [2,3]. [Q9] **P4.** SAR certification for pocket and body-worn use is tested at 0 mm and with child models, results published per device, and peak spatial SAR is also reported over 100 mg or 10 mg cubes [4,17]. **P5.** Exposure surveys report peaks, modulation, polarization and multi-source totals beside averages.

[Q9, Q10(b), Q17(c)] **P6.** NIOSH establishes surveillance of occupational RF exposure for tower, broadcast, utility and medical workers, with worker information on exposure, symptoms and reporting modeled on Directive 2013/35/EU and safety programs following IEEE C95.7-2022 [31,50]. [Q11(b)] **P7.** The FCC rule treats pregnant workers and the fetus as members of the public, as ICNIRP 2020 does, and body-worn device certification adds pregnant models [2,32].

[Q9, Q16, Q17(b), Q17(c)] **P8. National Program.** HHS convenes the four-stage program EFEIA has designed (Table 4) [16], covering ELF to microwave sources, with universities, professional organizations and the agencies responsible for communications, measurement and occupational exposure, as a continuing capability rather than a single campaign. Stage 1 extends P2. Stage 3 provides the clinician education ANSES and WHO call for [36,37]. Stage 4 builds, with NIEHS and CDC, a literacy module for the public and schools grounded in environmental health literacy [49], limited to behaviors with measured dose reduction [8] and tested in R6, and gives local governments the disclosure wording tested in R10.

Table 4. The four stages of the National Program [16]. Each output informs the next stage; scientific updates feed back into all four.

Stage	Work	Output
1. Evidence integration	Universities, professional societies, metrology and public health specialists, with declared interests and external review, assess evidence for and against current criteria by exposure conditions, measurement quality, endpoint, reproducibility and real-world relevance, keeping biological responses apart from demonstrated adverse effects	Evidence synthesis and common technical glossary
2. Criteria and consensus	Frequency, duration, temporal variability, simultaneous sources, actual use and differing populations (Table 1, G2-G8); peer review and public consultation; disagreements retained; any new numerical limit justified on its own	Consensus framework with evidence boundaries and periodic revision
3. Professional	Shared foundation, then pathways for engineers, clinicians (symptoms,	Competency framework,

education	differential diagnosis, referral, limits of attribution from exposure history) and public and occupational health; pilots and accredited continuing education	university modules, evaluated courses
4. Public education	Guidance for households, schools, workplaces and local authorities, co-developed with communities, tested for comprehension and effects on anxiety, separating measured exposure reduction from health benefit and unverified product claims, with a public channel for corrections	Tested public resources at the professional evidence standard

Related: Sections 1 (instrumentation), 2 (urban electromagnetic monitoring), 3 (EHS and health conditions) and 4 (shielding and consumer products).

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