

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

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Federal Register: September 21, 2026, 91 FR 59792

Docket ID: HHS-OASH-2026-0397

Introduction and Respondent Perspective (Question 2)

This submission is provided on behalf of the Swedish Radiation Protection Foundation, a Swedish non-profit organization dedicated to research and disseminating scientific information on the potential adverse health effects of exposure to radiofrequency electromagnetic fields (RF-EMF).

Our response represents the perspective of an independent public health advocacy organization with a particular focus on scientific research concerning the health effects of RF-EMF exposure, exposure standards, and the protection of the public from potential adverse health effects. Our response focuses primarily on our observations in Sweden and the research we have conducted in collaboration with Dr. Lennart Hardell, while also drawing on findings from international research.

The following comments address selected questions in the HHS Request for Information published in the Federal Register on September 21, 2026 (Document No. 2026-19252). They are based on peer-reviewed scientific research, scientific reviews, regulatory documents, and reports of health problems received from individuals who consider their symptoms are associated with RF-EMF exposure

Public Experiences and Reported Potential Adverse Health Effects (Question 3)

Numerous individuals in Sweden have contacted us describing a range of ill health effects from exposure to RF/EMF from various sources (mobile phones, Wi-Fi, smart meters, mobile phone masts and base stations or occupational equipment). In most cases the individuals report sleeping problems or even severe insomnia, headaches, fatigue, pressure over the chest, heart arrhythmia, tinnitus, anxiety, skin effects, dizziness, depression, concentration and memory impairment. The effects have generally appeared shortly after new antennas, smart meters or Wi-Fi routers have been deployed close to their dwellings, schools or work places (1,2,3,4).

There have also been reports that persons using a mobile phone for many hours a day during a long period of time have been diagnosed with malignant brain tumors or acoustic neuroma.

There appears to be considerable variation in individual sensitivity to RF exposure, with some individuals developing symptoms at very low exposure levels, while others experience adverse health effects only at substantially higher levels.

Smart meters and 5G antennas seem to trigger symptoms among people that have previously not reacted to similar exposure. We have also reports of development of cognitive impairment/dementia among elderly/senior individuals after having a Wi-Fi router close to bed or mobile phone antennas close to their apartments, bedrooms or workplaces. See for instance this report of a woman who worked for several years close to a 4G antenna and later developed Alzheimer's (5). I have observed older persons around 80 years of age developing initially memory impairment followed by dementia after 3G antennas were placed close to their apartment, and a person aged 94 that rapidly developed cognitive impairment after exposure to a Wi-Fi router above the bed in the elderly care home and a 5G antenna exposing the person to high RF radiation at 200 meter distance.

Reported Potential Adverse Health Effects (Question 4)

In collaboration with Dr Lennart Hardell, a scientist affiliated with the Environment and Cancer Research Foundation in Sweden who has published over 400 peer reviewed scientific articles, we have found that individuals who had 5G antennas installed near their homes rapidly developed symptoms previously described as the microwave syndrome or radiofrequency illness (6). The onset of symptoms was temporally associated with the installation and activation of 5G base stations. We have published eight case studies and one summary of seven of the studies (7-16). These case studies appear to be the only studies published so far on potential health effects on people living close to 5G antennas, thus representing real life exposure. The total number of persons studied was 17, their age varied between 4 and 83, including four children aged 4-8 years. The most frequently reported and most severe symptoms experienced after the deployment of 5G antennas were **sleeping problems, fatigue, headache, agitation, concentration- and memory problems, and skin problems**. Our measurements of RF-radiation in the studied person's homes showed that 5G antennas caused very high exposure. In the first case study (7), a base station providing 3G and 4G services had previously been operating at the same location, without the individuals studied reporting any associated health problems.

However, following the installation of 5G antennas, RF radiation exposure levels increased substantially, and both individuals developed severe health problems within two days. Similarly, in other case studies, we observed that individuals who had previously experienced no adverse health effects from exposure to 3G and 4G base stations developed health problems relatively rapidly following the upgrade of these base stations to 5G.

We also observed that when people moved from the 5G exposed apartment, house or office, to dwellings with much lower exposure, the reported symptoms subsided relatively quickly. This could be considered a classic provocation test.

Our case studies also included an eight-year-old boy who developed severe headaches while attending a school located approximately 200 meters from a 5G base station (15).

These findings are consistent with those of both earlier and more recent studies conducted by independent research groups, which have reported an increased risk of the following symptoms among individuals living in close proximity to mobile phone towers or base stations: sleep problems, headache, fatigue, dizziness, memory- and concentration problems. Studies have also found increased risk of cancer, one study an increased risk of ALS, among people living near base stations (17).

We have also analyzed Swedish public health data from the Swedish National Board of Health and Welfare's national patient register on numbers of patients in specialized outpatient care diagnosed with codes for sleeping problems each year 2001 - 2024. A clear and rapid increase in the number of patients diagnosed with sleeping problems in the age groups 0-4, 5-19 and 20-39 years, was observed, mainly between 2010 and 2024 (18). In addition we analyzed corresponding data on the diagnosis for memory problems each year in Sweden between 2001 and 2024 among children aged 5-19 years and also number of children aged 5-19 years that had consulted a physician in Norway for memory problems each year 2006-2024. In Norway the number of consultations increased from 179.51 in 2006 to 1,522.40 per 100,000 inhabitants in 2024, representing an 8.5-fold increase. The increase was particularly pronounced in recent years. A similar trend was observed in Sweden, where the annual number of patients diagnosed with mild cognitive impairment (R41.8) increased markedly, particularly from 2010 onwards. The number rose from 0.86 patients per 100,000 inhabitants in 2010 to 51.531 in 2024, representing an almost 60-fold increase over this period (19).

These trends may be associated with effects from children's and adolescent's increasing exposure to microwave RF radiation during the studied time period.

Exposure standards and risk assessments (Question 5)

The exposure limits established by the FCC and ICNIRP, which are based on protection against thermal effects, permit levels of exposure that a substantial number of scientific studies repeatedly have associated with adverse effects on human health and the environment. Consequently, scientists have repeatedly called for substantially lower and more protective exposure limits, including through the EMF Scientist Appeal and the EMF Call (<https://emfscientist.org/> and <https://www.emfcall.org>).

Based on our experience and numerous scientific studies involving both humans and animals, adverse health effects have been reported at exposure levels well below the limits established by the FCC and recommended by ICNIRP. There is also a considerable variation among people: some people are considerably more sensitive and react negatively at levels that many others tolerate without problems. We consider the recommendations proposed by EuropaEM published in 2016, EuropaEM EMF Guideline (20) to be the best option for federal health agencies to consider in order to protect the public, including sensitive subgroups, against harmful long term effects.

These guidelines take into account particular sensitivity of some individuals, if the exposure is daytime or nighttime and also the source of RF-EMF exposure (WiFi, 3G or Radio/TV etc.). 5G is not evaluated, since 5G was rolled out several years after the EuropaEM EMF Guideline publication in 2016.

We have analyzed the ICNIRP limits (similar to FCC limits that primarily only protect against acute thermal effects) and compared them with the EuropaEM EMF Guidelines, as well as with proposed precautionary limits from other organizations, in our article *Aspects on the International Commission on Non-Ionizing Radiation Protection (ICNIRP) 2020 Guidelines on Radiofrequency Radiation* (7). The exposure limits proposed by EuropaEM are orders of magnitude lower—by factors of millions—than those recommended by ICNIRP.

What scientific evidence exists about potential adverse health effects caused by current exposure limits? (Question 6)

There are several thousands of studies that have reported adverse health or biological effects from exposure below current exposure standards, thus effects that are not prevented by current exposure limits. Adverse health effects, including increased risk of cancer, have been reported in studies on people living close to mobile phone masts (17) although the included individuals have been exposed to levels well below current FCC and ICNIRP exposure limits.

Studies on harmful biological and health effects have been documented for instance in the Bioinitiative report 2012 (21), and in the list of studies compiled by Professor Emeritus Henry Lai, and presented on SafeEMR by Dr Joel Moskowitz, concluding that the majority of RF-exposure studies published since 1990 has reported significant negative effects (22). According to this compilation of 1,910 studies on oxidative stress, genetic effects, neurological effects and reproduction effects:

“89% (n=390) of 438 RFR oxidative effects (or free radical) papers published since 1997 reported significant effects including 96% (n=110) of 114 studies with a SAR (specific

absorption rate) ≤ 0.40 Watt per kilogram (which is ten times less than the 4.0 W/kg threshold of harm that the FCC and the ICNIRP use to base their RFR exposure limits).

72% ($n=396$) of 550 RFR genetic effects papers published since 1990 reported significant effects including 192 (84%) of 228 studies on gene expression.

78% ($n=396$) of 507 RFR neurological papers published since 2007 reported significant effects.

85% ($n=354$) of 415 RFR reproduction and development papers published since 1990 reported significant effects. Among the low-intensity exposure studies that reported significant effects, 73 studies used an exposure with a SAR $\leq 0.40 \text{ W/kg}$ and 53 studies had a SAR $\leq 0.08 \text{ W/kg}$.

260 low-intensity RFR exposure studies (SAR $< 0.40 \text{ W/kg}$) published since 1990 reported significant effects.”

See also the studies mentioned previously in this comment (8-16). Studies have also reported harmful effects on children when exposed to the mother’s use of mobile phones during pregnancy, analyzed in a systematic review from Columbia University (23). Large cohort studies have found an association with mother’s use of mobile phones during pregnancy and behavior problems, particularly hyperactivity/inattention problems (24). In one of the cohorts from Denmark, the highest risk for behavioral problems was found in children exposed both during fetal period and after birth. Several animal studies confirm that exposure during fetal period may result in behavior changes and harmful effects on the brain and other organs. Yale University scientists observed that mice exposed to mobile phone radiation during fetal period were hyperactive and had impaired memory. The scientists found that the behavioral changes were caused by altered neuronal developmental programming (26).

What, if any, technical and exposure-related information should be disclosed to consumers, residents, workers, schools, healthcare providers, and local governments? (Question 9)

a) The scientific basis for exposure limits. If the current FCC exposure limits are maintained, the public should be clearly informed that these limits are primarily designed to protect against established adverse effects of acute heating and do not protect against potential adverse health effects arising from non-thermal mechanisms or long-term exposure. However, if the limits are revised to also address non-thermal effects and adverse health effects associated with long-term exposure, the FCC should explicitly identify which short-term and long-term effects have been considered and how the scientific evidence concerning these effects has been incorporated into the revised limits.

b) Potential health effects reported in several studies such as increased risk of cancer, fertility problems, effects on brain and well-being and risk of symptoms such as sleeping

problems, headache, memory- and concentration problems, effects on the heart and other organs. Health care providers should be informed about these effects so they may consider RF exposure in encounters with patients with the various symptoms that have been associated with RF exposure.

c) Particular risk to and sensitivity of the child from exposure during pregnancy and early childhood.

d) Some individuals may be particularly sensitive to the radiation and experience symptoms at levels that others tolerate without problem.

e) Information and recommendations on reducing RF exposure. The public should be provided with clear, practical guidance on how to minimize exposure to RF radiation, including by prioritizing wired connections and Ethernet-based solutions, maintaining a greater distance from RF-emitting devices and sources, and limiting the duration of wireless device use.

f) Recommendations to keep mobile phone masts and base stations at 500 m distance from residential buildings, schools, elderly care facilities, and hospitals, accompanied by regular measurements and monitoring of RF radiation exposure levels

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: (Question 10)

a. disease registries. Yes – these could be used to analyze if health effects reported in scientific studies have increased in conjunction with increasing exposure in the general population. See for instance our studies on memory problems, sleeping problems, brain tumor and thyroid cancer incidence (18-19, 27-28).

b. occupational monitoring. Yes, very important that workers exposed to high RF radiation are monitored.

c. environmental monitoring. Yes. Effects on birds and other wild animals, and cows, horses, pigs, cats, dogs are not sufficiently investigated. It would be valuable to have a register to which reports of harmful effects on animals could be reported. The potential adverse effects of RF radiation exposure on birds, other wildlife, and domestic animals, including cattle, horses, pigs, cats, and dogs, remain insufficiently investigated. Establishing a national reporting system to systematically collect and document suspected adverse health effects in animals associated with RF exposure would be valuable. Such a system could facilitate the identification and investigation of cases similar to those reported in France (29, 30).

d. longitudinal cohort studies. Yes

e. biomonitoring. This is important for studies of exposure levels, environmental health, and to identify risks. It should be used as biological markers on health effects and support health protection. Analysis of e.g. blood and urine should be included.

f. adverse event reporting. Very important. There should be a national (or international) reporting system to systematically collect and document adverse health effects from exposure to Wi-Fi, smart meters, mobile phones, base stations and cell towers similar to the registries for adverse events from pharmaceutical products.

g. disease or illness clusters. This is also very important, particularly disease or illness clusters around mobile phone masts or base stations. There are many such reports during the last 25 years in the news-media (examples in 31, 32)

h. Other. A comprehensive information and training program for healthcare professionals and authorities should be established on non-thermal health effects from RF-radiation.

Should exposure assessment or risk evaluation differ for sensitive populations such as those noted below? (Question 11)

a. children. Yes, children are generally more sensitive due to developing nervous system and higher absorption of RF radiation. Studies have shown fetal and early childhood exposure was associated with behavior problems at age 7 in a large Danish cohort study (25) and animal studies have confirmed that fetal exposure may cause various health impacts on the offspring.

See also recommendations regarding children from ICBE-EMF august 2026 and references (33).

b. pregnant women. Yes. Several studies have shown negative effects on the child due to exposure during pregnancy (23). Animal studies have also reported detrimental effects on various organs including the brain from exposure during fetal time period (26).

c. older adults. Yes. Older adults could be more sensitive to memory/cognitive impairment, and dementia according to observations. Older adults also generally have weaker immune system. There are no scientific studies investigating potential harmful health effects on older adults.

d. individuals with implanted medical devices. Yes. Implanted devices may act as antennas, thus increasing the sensitivity of the individual with implant.

e. workers with elevated occupational exposure. Yes. Several studies of workers with elevated occupational exposure, such as within the military sector, has showed increased risk of cancer. Therefore occupational high exposed workers must be better protected by information on potential health risks including cancer, and stricter limits than those recommended by FCC and ICNIRP (34).

f. individuals with preexisting medical conditions. Yes. RF radiation has been associated with reduced well-being, depression, anxiety, concentration and memory problems. Individuals with related diagnoses may be particularly affected by RF exposure.

g. Other populations that may uniquely experience potential adverse health effects in response to RF radiation. Yes those who have developed high sensitivity (EHS) often due to previous high exposure to toxins, mercury (often amalgam), or EMF/RF. These individuals may develop severe symptoms at very low exposure levels, see recommendations in EuropaEM EMF Guidelines 2016 and statement on EHS from ICBE-EMF (<https://icbe-emf.org/activities/electrohypersensitivity/>).

What scientific evidence exists regarding potential adverse health effects associated with RF radiation exposure at levels below current federal exposure limits? (Question 12)

There is extensive scientific evidence demonstrating a wide range of adverse health and biological effects associated with exposure to RF radiation at levels below the current FCC and ICNIRP limits.

Effects clearly shown include oxidative stress, genetic effects, DNA-damage, harmful effects on the brain including on memory, cognition, and reproduction (22). Further, there is evidence for cancer, brain tumors associated with mobile phone use, thyroid cancer and breast cancer from mobile phone use (28,35,36). The microwave syndrome (sleeping problems, headache, nausea, fatigue, memory- and concentration problems, depression, effects on cardiovascular function etc.) are repeatedly found among people living close to mobile phone masts or antennas (17). About 60 studies have found negative impact on memory (37). The negative impact on the nervous system was already described in the scientific literature during 1960-1970. The former Soviet Union considered these effects to be sufficiently well established and therefore introduced exposure limits by that time for the general public that were substantially lower than those still applied today by the FCC and ICNIRP (6). There is also substantial evidence from animal studies that RF radiation may cause harmful effects on the brain linked to degenerative diseases but there are no studies that have investigated such effects on humans in epidemiological studies. There are, however, studies showing increased risk of Alzheimers, and dementia among people exposed to increased levels of low frequency magnetic fields (38)

According to scientific evidence, how do the technologies below affect cumulative exposure patterns? (Question 13)

a. 5G has led to huge increase in exposure according to our studies (8-16). 5G roll-out has entailed an increasing number of antennas emitting higher RF-levels.

b. 6G will likely contribute to increased exposure.

c. Wi-Fi has led to higher exposure of the populations, due to its increasing use in homes, workplaces, elderly homes, schools, high schools etc. during the last decades. If HHS would recommend that Ethernet cables were prioritized due to health risks associated with Wi-Fi exposure – the overall public exposure to RF radiation would likely be considerably reduced.

k. Communication enabled smart meters have contributed to an increasing exposure of the public and there are numerous anecdotal reports of severe health problems that occurred after the installation of smart meters. There is only one scientific study that investigated health effects associated with smart meters (39).

What scientific evidence exists regarding potential adverse environmental effects associated with RF radiation? (Question 14)

Professor Henry Lai and Blake Levitt have published a series of scientific papers. Quote: *“Part 1 questions today's ambient EMF capabilities to adversely affect wildlife, with more urgency regarding 5G technologies. Part 2 explores natural and man-made fields, animal magnetoreception mechanisms, and pertinent studies to all wildlife kingdoms. Part 3 examines current exposure standards, applicable laws, and future directions. It is time to recognize ambient EMF as a novel form of pollution and develop rules at regulatory agencies that designate air as 'habitat' so EMF can be regulated like other pollutants. Wildlife loss is often unseen and undocumented until tipping points are reached. Long-term chronic low-level EMF exposure standards, which do not now exist, should be set accordingly for wildlife, and environmental laws should be strictly enforced.”* (40)

A scientific study documented congenital malformations on piglets and reduced fertility on a pig farm close to a mobile phone mast in Germany in 2009 (41). A study found increased rates of calves with cataract after erection of a mobile phone base station (42)

What types of scientific evidence should be considered when evaluating RF exposure associated with wireless infrastructure? (Question 15)

a. proximity to homes, schools, childcare facilities, healthcare facilities, and/or workplaces. Studies on health effects in people living close to antennas (8-17).

b. cumulative neighborhood exposure. See (8-17).

c. antenna density. See (8-17).

e. livestock. See (41-42)

What are the highest priority research gaps regarding EMF and RF radiation and public health that the federal health agencies should address? (Question 16)

Further research is needed to investigate the potential health effects of continuous, 24-hour exposure to RF radiation from mobile phone masts, base stations, and Wi-Fi networks. Such studies should include comprehensive measurements and assessments of total RF radiation exposure from all relevant sources in residential environments, workplaces, schools, elderly care facilities, and other settings where people spend substantial amounts of time.

In view of the high number of masts and antennas around the world there are relatively few studies on the potential impact on people's health, for instance various forms of cancer, degenerative diseases, and the group of symptoms identified already in early East European studies on workers exposed to pulsed microwave RF radiation called the microwave syndrome or radiofrequency illness. There is also a lack of research investigating effects from exposure to Wi-Fi routers, use of smart phones or laptops and the risk of developing cancers other than brain tumors.

These devices are held for prolonged periods of time close against the chest and abdomen. Studies on cancer risk in the close proximity are therefore important. Some high priority research topics are proposed below:

1. Potential increased risk of neurodegenerative diseases from long term exposure to RF radiation from mobile phones, wireless headphones or earbuds, Wi-Fi, and base stations.
2. Other cancer types than brain tumors associated with long term exposure to smart phones or wireless headphones.
3. Potential effects on health from 5G and 4G base stations primarily the microwave syndrome, cancer, neurodegenerative diseases, etc.
4. Potential effects on health from 6G radiation
5. Potential effects on health from smart meters.
7. Potential effects on blood cells in humans, for instance rouleaux formation, from exposure to mobile phones, Wi-Fi (43).

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 (Question 18)

Source of funding, conflicts of interests and direct or indirect ties to telecom or military industry must be considered when evaluating the evidence. It is a well-known fact that the telecommunication and military industry sectors are defending and promoting the FCC and ICNIRP thermal based limits, although they are insufficient to protect against many well documented negative health and biological effects. One example is a brochure from GSMA –

a global organization representing mobile operators, published shortly after the publication of the ICNIRP 2020 limits, that promotes the ICNIRP limits (44).

These industries also fund studies/scientists that in general report no effects below these limits. Examples of such industry funded studies are the Danish Cohort, the Cosmos study and the Cefalo study on brain tumor risks associated with mobile phone use (7,27,45).

There is evidence that the WHO's department for RF and health, the EMF Project, is not objective but biased in favor of the industry, the ICNIRP thermal based limits and consults mainly ICNIRP members as experts. The WHO EMF Project was funded by telecom industry organizations for around 10 years, from its creation in 1996 until 2006 (45,46). Still today, although the industry funding of the WHO EMF Project has officially been terminated, the WHO maintains an opinion of no effects below the ICNIRP limits, that benefits the industry. ICNIRP affiliated experts generally maintain the opinion that there are no negative impacts below the ICNIRP limits (7,45). A similar problem of disproportionate influence by ICNIRP-affiliated scientists can be observed in expert assessments to the European Commission (SCENIHR 2007-2015 and SCHEER 2023), which have likewise concluded in favor of maintaining the ICNIRP exposure limits (7,). ICNIRP-affiliated experts thus reappear in expert groups of influential organizations such as the WHO, the EU, the Swedish (SSM) while on the other hand the scientists critical of the ICNIRP limits are not represented, giving ICNIRP experts proportionally high influence over the outcome of several national and international expert reports (7).

In a brochure published in October 2026 the GSMA once again promotes the ICNIRP and the WHO and encourages *"countries to ensure that national RF- EMF policy includes: — adoption of the ICNIRP (2020) international RF-EMF exposure limits ... —effective public communication using information from credible sources, such as the WHO and ICNIRP"*. GSMA also claim that *"the consensus among independent scientific experts is that the ICNIRP limits provide protection for all people against all established health hazards from short- or long-term RF-EMF exposures."* (48). That statement is obviously false in view of the EMF scientist appeal (www.emfscientist.org) and the EMF Call (www.emfcall.org).

A report commissioned by former members of the European Parliament, Michèle Rivasi and Klaus Buchner, examined a network of ICNIRP-affiliated scientists and experts with ties to industry, describing a closely interconnected network of experts whose assessments consistently favor industry interests. These assessments from the WHO, EU, and national scientific reviews, repeatedly conclude that there are no adverse health effects at exposure levels below the ICNIRP and FCC limits and therefore that the ICNIRP limits provide sufficient protection against harmful health effects. The investigation found that *"the majority of ICNIRP-scientists did perform research partly funded by industry"* (49).

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