Response of AMICA APS to the HHS Request for Information on Electromagnetic Fields, Radiofrequency Radiation, and Wireless Radiation Exposure

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Organisational Perspective and Reports of Adverse Health Effects

Question 2 — Please identify the perspective represented by your comments.

These comments are submitted by AMICA APS, an Italian non-profit organisation that operates at the European level to promote research into the links between the environment and health and to represent people affected by environmental illnesses.

Question 3 — Experiences of potential adverse health effects associated with RF/EMF exposure

Since 2003, AMICA has collected testimonies from individuals reporting the onset or worsening of symptoms shortly after using wireless devices or following changes in their electromagnetic environment, particularly the installation or activation of telecommunications infrastructure.

Over more than twenty years, AMICA has observed three distinct periods of marked increases in such reports, coinciding with major developments in wireless technology.

The first occurred during the expansion of **3G/UMTS mobile telecommunications**, when increasing numbers of individuals began associating the onset of symptoms with mobile telephone use and the growing presence of wireless infrastructure.

The second coincided with the widespread adoption of **Wi-Fi networks** in homes, workplaces, schools and public environments. During this period, AMICA received a further substantial increase in reports of symptoms attributed by affected individuals to wireless routers and other transmitting devices.

The third began in 2025, when AMICA began receiving a particularly sharp increase in reports from individuals describing the sudden onset or worsening of symptoms shortly after the installation or activation of 5G base stations near their homes or workplaces.

These observations are based on testimonies received directly by the association, rather than on a population-based epidemiological study. They therefore do not establish a causal relationship between RF-EMF exposure and the reported symptoms. Nevertheless, the recurrence of similar temporal patterns across successive generations of wireless technology, together with the consistent reporting of the same symptoms, constitutes a potential public health signal that should not be disregarded.

Affected individuals frequently report that the only positive treatment is to avoid or reduce their exposure to environments with wireless radiations.

In our experience, those who most frequently report symptoms associated with radiofrequency radiation exposure are patients with neurological conditions, such as small fibre neuropathy, multiple sclerosis and other neuropathies, as well as patients with fibromyalgia, chronic fatigue syndrome (ME/CFS) and multiple

chemical sensitivity (MCS). These conditions are associated with neurological dysfunction, increased oxidative stress and alterations in cerebral perfusion.

After more than twenty years of collecting these testimonies, AMICA considers it unacceptable for public health authorities to continue dismissing recurring reports of adverse health effects associated with RF exposure as isolated anecdotes. These reports constitute a persistent public health warning and, in AMICA's view, provide further grounds for questioning the adequacy of ICNIRP exposure limits, which have already been extensively criticised in independent scientific assessments, including the *BioInitiative Report* and the *Seletun Scientific Statement*.

Scientific references

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Question 4 — Observations that may help identify recurring patterns of potential adverse health effects

These symptoms associated with RF exposure can be simply explained by the numerous pieces of evidence of non-thermal mechanisms of RF that may affect living systems, including oxidative stress, DNA damage, alterations in cellular signalling and the proposed activation of voltage-gated calcium channels (Lai and Singh, 1995, 1996; Marinelli et al., 2004; Pall, 2013). Research has also indicated that biological responses may depend on signal characteristics, including pulsation and modulation (Belyaev, 2005). These findings provide a scientific basis for investigating patients' reports, although they do not, by themselves, establish the causes of the reported symptoms.

AMICA urges the Centers for Disease Control and Prevention (CDC), in coordination with the National Institutes of Health (NIH) and other relevant federal agencies, to establish a dedicated national surveillance programme for suspected adverse health effects associated with RF-EMF exposure. This programme should integrate patient testimonies, clinical assessments, independent environmental measurements and epidemiological data. It is important to emphasise that environmental measurements should take into account signal pulsation, not only intensity, because the underlying mechanism involves electromagnetic induction in living matter rather than merely tissue heating.

Particular attention should be given to the clinical history of patients reporting reactions to EMF/RF exposure, including the dates of installation or activation of wireless infrastructure, the onset and progression of symptoms, and exposure characteristics, including signal pulsation, modulation and peak intensity. Longitudinal clinical follow-up should investigate whether symptoms improve following exposure reduction, recur when exposure conditions change or persist despite reduced exposure, while accounting for other potential contributing factors.

Patient advocacy organisations should participate in developing these surveillance programmes and contribute anonymised information about recurring patterns. Independent researchers should assess these data using transparent scientific methods and appropriate safeguards for patient confidentiality.

Question 5 — Exposure Standards and Risk Assessment

5.n. What scientific, technical, or regulatory changes by federal health agencies could improve the assessment, disclosure, and regulation of wireless radiation exposure?

AMICA APS calls for a fundamental reform of RF-EMF risk assessment and regulation, ensuring that exposure standards are based on independent scientific evidence, transparent procedures and a comprehensive evaluation of biological effects, including those occurring without appreciable tissue heating.

Scientific independence must be the first priority. Federal health agencies should appoint advisers free from significant conflicts of interest, require full public disclosure of financial and institutional relationships.

AMICA APS considers that an industry whose commercial interests depend on the continued expansion of wireless technologies must not be allowed to influence the scientific evidence used to determine whether those technologies are safe for human health. The protection of human life and health must take precedence over commercial interests.

Studies commissioned, funded or controlled by telecommunications companies or their affiliated organisations should therefore be excluded from regulatory safety assessments, irrespective of their reported findings. This requirement would also reduce the incentive for companies to finance research institutions and private foundations with the aim of influencing the regulatory evaluation of their own technologies.

Safety assessments should instead rely on research conducted independently of the industries whose products and activities are being evaluated, with transparent funding arrangements, publicly accessible methodologies and full disclosure of potential conflicts of interest.

Findings that challenge existing exposure standards must not be dismissed without scientific justification, particularly when biological effects occur below regulatory limits or cannot be explained by tissue heating. Otherwise, risk assessment becomes circular: non-thermal effects are disregarded because they are not thermal, while existing standards are defended on the assumption that only thermal effects matter.

Experimental studies have reported DNA damage, oxidative stress, alterations in cellular signalling and other biological responses to RF-EMF exposure (Lai and

Singh, 1995, 1996; Marinelli et al., 2004). These findings warrant systematic evaluation of their reproducibility, underlying mechanisms and potential health implications.

Particular attention must be given to signal pulsation and modulation. Risk assessments should examine whether experimental exposure conditions adequately reproduce real-world signals, including their temporal structure, peak intensity and duration. Compliance with limits based predominantly on average energy absorption must not be treated as conclusive evidence of biological safety.

AMICA therefore urges federal health agencies to establish independent scientific advisory committees, mandatory conflict-of-interest disclosures, transparent evidence-review procedures and a comprehensive reassessment of the scientific basis of existing exposure limits.

Public health agencies must protect the population from potentially harmful exposures, not protect existing exposure standards from scientific evidence that challenges their validity.

5.o. Is additional research needed to develop, test, and evaluate the effectiveness of procedures and techniques for minimising exposure to radiation emitted by electronic products?

AMICA APS considers that the immediate priority is not to commission further research before implementing exposure-reduction measures. **The scientific literature already contains substantial evidence of biological effects associated with RF-EMF exposure**, including effects reported under conditions that do not produce appreciable tissue heating.

The central problem is the failure to translate existing scientific knowledge into effective preventive public health policies.

Experimental studies have reported oxidative stress, DNA alterations, changes in cellular activity, and other biological responses associated with RF-EMF exposure. Research programmes conducted over several decades have also raised concerns about the adequacy of standards based predominantly on thermal effects.

The work of Lai and Singh, the REFLEX research programme, and experimental investigations of the effects of pulsed electromagnetic fields illustrate the scientific basis for these concerns.

Further research may refine our understanding of exposure-response relationships, identify particularly vulnerable populations, and improve the quantification of long-term health risks. However, it must not be used as a justification for indefinitely postponing preventive action.

No additional research is required to establish that eliminating an RF-emitting source eliminates the exposure attributable to that source.

Practical alternatives are already available. Wired internet connections can replace Wi-Fi in many settings; wired communication systems can replace wireless systems where technically feasible; unnecessary wireless transmitters can be disabled; and the location and operation of transmitting equipment can be modified to reduce involuntary exposure.

The effectiveness of these measures in reducing exposure is a matter of established physical principles. Whether particular reductions produce measurable improvements in specific health outcomes is a separate scientific question.

AMICA APS is particularly concerned that public resources may continue to be devoted to repeatedly investigating questions for which substantial evidence already exists, while relatively little institutional effort is directed towards implementing available preventive measures.

Federal health agencies should prioritise the reduction of avoidable exposures, the provision of wired alternatives, independent pre-market safety assessments, and transparent public information.

Scientific uncertainty must not be transformed into a permanent justification for regulatory inaction.

5.p. How should an exposure classification system account for operating frequency, power density, specific absorption rate, electric and magnetic field strength, modulation, pulsing, duty cycle, beamforming, simultaneous exposure to multiple frequencies, exposure duration, distance from the source, proximity to the body, and cumulative exposure over time?

AMICA APS considers that existing exposure standards require fundamental revision because their underlying approach gives predominant importance to tissue heating and average energy absorption while inadequately addressing the potential biological effects of non-thermal interactions.

The biological effects of electromagnetic fields cannot be adequately characterised solely by average power density and the compliance with a thermal exposure limit must no longer be treated as conclusive evidence of biological safety.

A scientifically meaningful exposure assessment must also consider **the electric fields and currents induced within biological tissues**, the temporal characteristics of electromagnetic signals, modulation patterns, pulse duration, repetition frequency, peak intensity, and simultaneous exposure to multiple frequencies.

The importance of pulsed and modulated electromagnetic fields has been examined in experimental research and scientific reviews, including Belyaev (2005) and Batista Napotnik and colleagues (2016).

Martin L. Pall has also argued that conventional exposure guidelines fail to account adequately for the biological significance of **short electromagnetic pulses and pulse-modulated signals**.

In his analysis, averaging electromagnetic field intensity over periods of six or thirty minutes can conceal potentially relevant characteristics of exposure. Signals with comparable average power may have substantially different temporal structures and may produce different biological responses.

Pall also proposes that electromagnetic interactions with **voltage-gated calcium channels (VGCCs)** may contribute to non-thermal biological effects, potentially through changes in intracellular calcium signalling and downstream biochemical pathways (Pall, 2013).

This mechanism deserves independent scientific evaluation rather than dismissal solely because it falls outside the conventional thermal model.

Exposure standards must distinguish between average energy absorption and the biological consequences potentially associated with the temporal and spectral characteristics of the electromagnetic field.

Simultaneous exposure to multiple frequencies also requires particular attention. Different frequency components may induce distinct electromagnetic interactions within tissues. Their combined biological effects cannot automatically be assumed to be equivalent to those of a single-frequency exposure with the same average power.

Possible **additive or synergistic effects** should be investigated rather than excluded by assumption. Their magnitude cannot, however, be inferred simply by counting the number of frequencies present.

These considerations are particularly relevant to radar installations, Wi-Fi systems, and modern mobile telecommunications networks, including 5G, which may employ complex modulation, intermittent transmissions, multiple frequency bands, and dynamically varying signal characteristics.

AMICA APS therefore calls for biologically informed exposure standards that incorporate pulse characteristics, modulation, peak field strengths, induced internal fields, multiple-frequency exposure, cumulative duration, and chronic exposure conditions.

Question 6 — What scientific evidence exists regarding potential adverse health effects under current exposure limits?

AMICA APS considers that the scientific evidence accumulated over recent decades demonstrates serious deficiencies in existing radiofrequency exposure limits, particularly regarding carcinogenic hazards, chronic exposure and biological mechanisms other than tissue heating.

Current standards rely predominantly on thermal effects and energy-absorption metrics, without adequately incorporating evidence from experimental toxicology, epidemiology, molecular and cellular biology, and investigations of pulsed and modulated electromagnetic fields.

Evidence of carcinogenicity

In 2011, the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, as documented in IARC Monograph Volume 102 (2013). However, substantial additional experimental and epidemiological evidence has emerged since that evaluation.

The United States National Toxicology Program (NTP) conducted extensive long-term studies of RF radiation exposure in rats and mice. Its 2018 technical reports documented **clear evidence of carcinogenic activity in male rats**, based on malignant schwannomas of the heart following exposure to GSM- and CDMA-modulated radiofrequency radiation. Other findings, including malignant gliomas, also raised concern. Although these controlled experimental conditions cannot be directly equated with ordinary human environmental exposure, the results constitute important evidence for carcinogenic hazard identification.

An independent long-term investigation by the Cesare Maltoni Cancer Research Centre of the Ramazzini Institute examined Sprague-Dawley rats exposed from prenatal life until natural death to radiofrequency fields representative of emissions from mobile telephone base stations.

Falcioni and colleagues (2018) reported a statistically significant increase in heart schwannomas among male rats exposed to the highest field strength of 50 V/m, below the international reference level applicable at the frequency investigated. Other tumour findings were also reported, although not all reached statistical significance.

The Ramazzini investigation is particularly relevant because it examined far-field exposure, whereas the NTP studies employed exposure conditions more closely related to mobile telephone use. **The occurrence of related tumour types in two independent experimental programmes, despite substantial differences in exposure protocols, strengthens the evidence of carcinogenic hazard and warrants serious regulatory consideration.**

Epidemiological studies provide additional evidence. The INTERPHONE Study Group (2010) reported an elevated estimate of glioma risk in the highest category of cumulative mobile telephone call time, while acknowledging methodological limitations. Hardell and Carlberg (2015) reported associations between long-term mobile and cordless telephone use and glioma, while the French CERENAT study (Coureau et al., 2014) identified associations between heavy mobile telephone use and certain brain tumours.

AMICA APS believes that combined epidemiological and experimental evidence are sufficient to regard radiofrequency radiation as carcinogenic to humans (IARC Group 1). This position is consistent with the assessment advanced by Hardell and Carlberg (2016), who argued that the evidence warranted classification as a human carcinogen, and with subsequent evaluations incorporating additional experimental findings.

The convergence of findings from independent animal experiments and human observational studies provides substantial grounds for reassessing carcinogenic hazards rather than continuing to rely on standards developed primarily around thermal effects.

DNA damage, oxidative stress, and cellular alterations

Lai and Singh (1995, 1996) reported single- and double-strand DNA breaks in brain cells of rats exposed to radiofrequency electromagnetic fields, raising concerns about **genotoxic effects**. The European REFLEX research programme subsequently reported **DNA damage and cellular stress** responses under certain experimental conditions.

Marinelli and colleagues (2004) investigated cellular responses to radiofrequency exposure, including alterations in **cell survival and apoptosis.**

These findings are significant because DNA damage, oxidative stress, alterations in cellular signalling and disruption of regulatory mechanisms are biologically relevant endpoints. Although their implications for human disease require further

investigation, the absence of appreciable tissue heating does not justify disregarding experimentally observed biological effects**.**

AMICA urges federal health agencies to assess this evidence systematically, examining reproducibility, exposure conditions, potential biological mechanisms and implications for long-term health. Such findings must be evaluated on their scientific merits rather than excluded because they challenge the thermal assumptions underlying existing exposure standards.

Pulsed electromagnetic fields and the limitations of time-averaged exposure metrics

A critical limitation of existing RF-EMF exposure guidelines is their reliance on time-averaged measurements that may not adequately characterise the biological relevance of pulsed and modulated signals.

Belyaev (2005) reviewed experimental evidence indicating that biological responses to microwave exposure may **depend on signal characteristics** beyond average intensity, including frequency and modulation.

Pall has also questioned the adequacy of exposure assessments based predominantly on average intensity, arguing that short-duration peaks and temporal variations may be biologically relevant. He has proposed activation of **voltage-gated calcium channels** as a possible mechanism contributing to non-thermal biological effects (Pall, 2013).

Although the voltage-gated calcium channel hypothesis remains under scientific investigation and is not universally accepted as an established mechanism of RF-related health effects, it provides a testable explanation that should be examined rather than dismissed.

AMICA considers that regulatory assessments must explicitly address signal pulsation, modulation, peak intensity and exposure duration, rather than assuming that compliance with time-averaged limits is sufficient to establish biological safety.

Chronic exposure and experimental evidence from radar emissions

Evidence from epidemiological and experimental investigations of radar exposure raises serious concerns about the adequacy of safety standards based predominantly on thermal effects. Particular attention must be given to

chronic exposure, signal pulsation, genetic and epigenetic alterations, and possible reproductive and developmental consequences.

Brizzi and Marinelli (2018) investigated the health consequences of exposure to a military radar in Potenza Picena, Italy, examining 756 hospital admissions recorded between 1986 and 1991. The study considered cancer, cardiovascular diseases, miscarriages, congenital malformations and severe behavioural disorders, comparing disease occurrence across residential areas with different estimated levels of radar exposure.

The researchers reported statistically significant associations between greater radar exposure and increased cancer and cardiovascular disease risks. These results raise important questions about the long-term health consequences of residential exposure to pulsed radar emissions.

Experimental investigations conducted by Marinelli and colleagues in residential areas of Potenza Picena also reported changes in cellular responses associated with radar exposure. The researchers described activation of apoptotic processes following shorter exposures and increased cell-survival signalling after prolonged exposure exceeding 24 hours.

These observations suggest that exposure duration and signal characteristics may influence biological responses independently of substantial tissue heating.

Henry Lai, addressing the biological effects of radar and mobile telephone base-station emissions at the 2013 Potenza Picena scientific conference, emphasised the relevance of chronic, relatively low-intensity exposure and the possibility that waveform and frequency may influence biological outcomes.

Epigenetic alterations are especially relevant because changes in gene regulation may affect biological development without altering the underlying DNA sequence. Whether radar-related exposures can produce heritable epigenetic changes or contribute to disease in the offspring of exposed workers remains an important unresolved research question.

AMICA APS considers that these findings justify immediate precautionary measures against unnecessary chronic exposure to pulsed radar emissions, together with independent investigations of cancer, cardiovascular disease, reproductive outcomes and potential intergenerational effects.

Radar safety assessments must explicitly characterise pulse structure, peak intensity, repetition frequency and exposure duration. Compliance with

conventional time-averaged limits must not be treated as sufficient evidence of long-term biological safety.

Neurological, reproductive, and endocrine effects

Experimental studies have also reported potential effects of RF-EMF exposure on neurological function, reproductive biology, endocrine regulation and enzymatic activity, including alterations in oxidative balance, cellular signalling and physiological parameters.

Although findings vary in methodological quality and reproducibility, their potential relevance to human health cannot be determined solely by whether exposure produces appreciable tissue heating.

AMICA calls for independent, transparent scientific reviews of these research areas, in order ti adopt more cautelative safety limits.

Electromagnetic Hypersensitivity (EHS) and vulnerable populations

AMICA APS is particularly concerned about individuals affected by Electromagnetic Hypersensitivity (EHS), who report symptoms and functional limitations associated with exposure to electromagnetic fields, often experiencing substantial difficulties in accessing healthcare, public services and suitable living environments.

Although the causal mechanisms underlying EHS remain the subject of scientific debate, **uncertainty about causation must not be used to dismiss patients' symptoms, deny appropriate medical care or exclude affected individuals from public life**.

Existing exposure limits, established for the general population, do not necessarily account for differences in individual susceptibility. Children, pregnant women, people with pre-existing medical conditions (such as neuropathies, MS, FM or SFN) and individuals reporting EHS therefore warrant particular consideration in public health assessments.

AMICA urges federal health agencies to ensure appropriate healthcare and protection for these people against discrimination, and support reasonable environmental accommodations, including access to wired technologies and reduced-exposure environments.

The protection of vulnerable populations, in fact, must be an explicit objective of RF-EMF risk assessment and public health policy, rather than an issue deferred until all uncertainties concerning individual susceptibility have been resolved.

Conclusions and recommendations

The combined evidence from experimental carcinogenicity studies, epidemiological investigations, cellular and molecular research, and studies of pulsed electromagnetic fields raises substantial concerns about the adequacy of existing RF exposure standards.

The central regulatory question is not whether every reported biological effect has been conclusively demonstrated to cause disease. It is whether existing standards have adequately evaluated the full range of scientifically relevant evidence before being presented to the public as protective.

AMICA APS therefore calls upon the United States Department of Health and Human Services to initiate a comprehensive, independent reassessment of radiofrequency exposure standards, with particular attention to carcinogenicity, non-thermal biological effects, chronic exposure, signal pulsation and modulation, and vulnerable populations.

This reassessment must be conducted by experts free from significant relevant conflicts of interest, using transparent criteria that ensure full consideration of scientific findings challenging existing regulatory assumptions.

Pending this reassessment, federal health agencies should promote precautionary measures to reduce avoidable RF exposure, including the use of wired alternatives wherever practicable and additional protections for vulnerable populations.

Public health protection must not be postponed until every uncertainty has been resolved. The available evidence warrants both rigorous scientific reassessment and proportionate preventive action.

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Human Exposure Assessment and Public Health Surveillance

Question 7 — What scientific methods are currently available to accurately characterise radiofrequency exposure at individual and population levels?

AMICA APS considers that the scientific instruments required to measure radiofrequency electromagnetic field (RF-EMF) exposure are already available. However, **new measurement methods and instruments are needed to characterise signal pulsation, modulation and peak intensity**, which may influence biological responses but are not adequately captured by conventional time-averaged measurements.

This is particularly important for 5G, where beamforming technology directs radiofrequency signals towards individual users. **Personal dosimetry must therefore be developed to measure the actual exposure received by mobile device users**, including signal intensity, power density, pulsation and modulation. Conventional environmental monitoring alone cannot adequately characterise these dynamic, user-directed exposures.

Existing methods include calibrated broadband and frequency-selective measurements, spectrum analysis, personal exposure meters, continuous monitoring stations and spatial exposure modelling. These should be integrated with improved techniques capable of capturing the temporal and spatial characteristics of modern wireless transmissions.

AMICA APS calls for an independent, publicly funded RF exposure and health surveillance service, coordinated nationally and implemented through local public health authorities. This service should combine objective exposure measurements with appropriately protected, georeferenced health data to investigate potential associations between long-term exposure and disease incidence.

The epidemiological investigation by Brizzi and Marinelli (2018) in Potenza Picena, Italy, provides an example of how disease patterns can be examined in populations living near fixed electromagnetic emission sources, although radar and telecommunications infrastructure have different technical characteristics.

RF exposure monitoring must serve public health surveillance, not merely demonstrate compliance with existing regulatory limits.

AMICA APS also calls for a **precautionary moratorium on new technologies introducing additional RF exposure**, including radar systems for autonomous vehicles and commercial satellite constellations, pending independent health and

environmental assessments and the adoption of an enforceable **0.6 V/m maximum limit for long-term public exposure**.

This limit should apply to **cumulative exposure from all relevant RF sources**, rather than separately to each technology or operator. No new wireless infrastructure should be deployed without safeguards against further increases in involuntary population exposure.

Question 8 — What improvements should be made to exposure assessment methodologies to better reflect real-world exposure conditions?

Current RF-EMF exposure assessments are primarily designed to demonstrate compliance with regulatory limits. Short-term, time-averaged measurements cannot adequately characterise prolonged, cumulative exposure or the dynamic behaviour of modern wireless technologies.

AMICA APS calls for standardised measurement protocols that reflect actual exposure conditions in homes, schools, hospitals and workplaces. Assessments should include peak intensity, signal pulsation and modulation, exposure duration, simultaneous frequencies and variations in transmission activity.

Particular attention must be given to 5G beamforming, which directs radiofrequency signals towards individual users rather than transmitting uniformly across a coverage area. Conventional measurements at fixed locations may therefore fail to capture the exposure experienced by users of mobile devices. **New personal dosimetry methods are needed to measure dynamic, user-directed exposure**, including signal intensity, power density, pulsation and modulation under realistic operating conditions.

Long-term residential assessments should reconstruct exposure histories, documenting changes in antenna configurations, transmission power, frequencies and surrounding infrastructure. Distance from a base station alone is not a reliable indicator of actual exposure.

AMICA APS urges federal health agencies to establish independent, continuous RF-EMF monitoring, coordinated by public institutions and supported by a national database of current and historical measurements. These data should be linked, under strict privacy safeguards, to epidemiological surveillance to investigate possible associations between cumulative exposure and disease incidence.

Exposure assessment must move beyond regulatory compliance to establish the actual intensity, characteristics and duration of population exposure, providing a scientific basis for health research and preventive measures**.**

Question 9 — What technical and exposure-related information should be disclosed to consumers, residents, workers, schools, healthcare providers, and local authorities?

AMICA APS considers that people have a fundamental right to know the extent and characteristics of the radiofrequency electromagnetic fields to which they are exposed, particularly when exposure is involuntary and originates from telecommunications infrastructure installed near homes, schools, workplaces or healthcare facilities.

Telecommunications operators should be legally required to disclose the location, operating frequencies, transmission power, antenna orientation, emission characteristics and operational history of every mobile telephone base station. Disclosures should also cover signal pulsation and modulation, peak emissions, the activation of additional frequency bands, changes in technology and modifications affecting exposure conditions.

Residents and local authorities should receive advance notification of proposed installations or substantial modifications to existing infrastructure, together with accessible technical information and the results of independent exposure assessments.

Environmental exposure measurements should be publicly available through an independently managed national database, supported by detailed local maps showing measured electric field strengths, temporal variations and, where technically feasible, the contributions of individual transmitting sources.

The database should preserve historical measurements and records of infrastructure changes, enabling residents and researchers to reconstruct long-term exposure histories. This information is particularly important for epidemiological investigations into diseases with potentially long latency periods.

Schools, hospitals and residential care facilities should receive specific information about nearby transmitting installations and measured exposure levels. Healthcare professionals should have access to relevant environmental data when investigating possible relationships between patients' symptoms and exposure conditions.

Local authorities must have access to the technical information necessary to assess proposed installations and participate meaningfully in decisions affecting their communities. Information intended for residents should be presented in clear,

accessible language, without concealing scientific uncertainties concerning potential long-term health effects.

AMICA rejects a regulatory system in which telecommunications operators possess detailed information about the emissions generated by their infrastructure while residents, healthcare professionals and public authorities lack equivalent access to relevant exposure data.

Question 10 — What data sources or surveillance systems currently exist to monitor potential adverse health effects associated with RF exposure? Should additional systems be developed?

AMICA APS calls for the establishment of a mandatory, nationwide epidemiological surveillance system capable of investigating potential associations between exposure to radiofrequency emissions from mobile telephone base stations and health outcomes among surrounding populations.

Existing public health resources, including cancer registries, disease surveillance systems, hospital records, population health surveys and environmental monitoring networks, provide valuable information. However, these resources are not routinely integrated with individual residential exposure histories and independently measured RF-EMF levels in a coordinated national programme specifically designed to investigate potential health effects of telecommunications infrastructure.

The absence of such systematic, exposure-linked epidemiological surveillance represents a serious gap in public health protection, particularly for populations experiencing prolonged, involuntary exposure.

Several epidemiological investigations have reported findings that warrant further examination:

- Eger et al. (2004), in the German Naila study, reported increased cancer incidence among residents living within 400 metres of a mobile telephone transmission mast.
- Wolf and Wolf (2004) reported increased cancer incidence among residents living near a cellular telephone transmitter station in Israel.
- Hutter et al. (2006) investigated subjective symptoms, sleep disturbances and cognitive performance, reporting associations between measured exposure and certain symptoms, particularly headaches, at levels below existing reference limits.
- Abdel-Rassoul et al. (2007) reported a higher prevalence of certain neurobehavioural symptoms among residents living near mobile telephone base stations.
- Dode et al. (2011) examined geographical patterns of mortality from neoplasms in relation to mobile telephone base station locations in Belo Horizonte, Brazil.

- Balmori (2022) reviewed studies concerning populations living near mobile telephone base stations, including investigations reporting symptoms, biochemical alterations and cancer-related outcomes.

These studies differ considerably in design, exposure assessment, sample size and methodological quality. They do not individually establish causation, but their findings justify further independent investigation through coordinated epidemiological surveillance.

AMICA proposes that local public health authorities establish dedicated environmental epidemiology services, coordinated nationally by an independent public health institution and working in collaboration with environmental monitoring agencies.

As an initial surveillance priority, particular attention should be given to populations living within 500 metres of transmitting installations, without treating this distance as a scientifically established boundary of risk. Actual exposure must be assessed through independent measurements rather than distance alone.

The surveillance system should integrate cancer and disease registries, environmental RF measurements, residential and occupational exposure histories, infrastructure installation and modification records, and longitudinal clinical data, subject to appropriate privacy safeguards.

Its principal objectives should be to identify geographical and temporal patterns of disease, investigate changes in health outcomes following the installation or modification of telecommunications infrastructure, and assess potential exposure-response relationships while accounting for relevant confounding factors.

Disease registries and identification of disease clusters

Cancer registries, neurological disease registries and other relevant health databases should be integrated with geographical and historical RF exposure information through privacy-protective epidemiological procedures.

Particular attention should be given to brain tumours, schwannomas, haematological malignancies, neurological disorders, sleep disturbances and other health outcomes identified as potentially relevant in the scientific literature.

The identification of unusual geographical or temporal concentrations of disease should trigger formal epidemiological investigations, including comparisons with

appropriately selected reference populations, independent exposure assessments and consideration of potential confounding factors.

Occupational exposure monitoring

Workers involved in the installation, maintenance and operation of telecommunications infrastructure should be included in dedicated occupational health surveillance programmes.

These programmes should document exposure intensity, duration, frequencies, signal pulsation and modulation, peak emissions and relevant occupational health outcomes, with appropriate longitudinal follow-up.

Environmental monitoring

Continuous environmental RF monitoring should be established in residential areas, schools, hospitals and workplaces near telecommunications installations.

Measurements should be conducted by independent public institutions using standardised procedures and calibrated equipment, with particular attention to temporal variations, cumulative exposure from multiple sources and relevant signal characteristics.

Historical exposure records should be preserved to support investigations into diseases with potentially long latency periods.

Longitudinal cohort studies

Prospective population cohorts should be established to investigate potential long-term health consequences of environmental RF exposure.

Participants should undergo repeated exposure assessments and systematic health evaluations over time. Studies should incorporate appropriate comparison groups and account for age, socioeconomic circumstances, occupational exposures, lifestyle factors and other relevant confounders.

Biomonitoring

Where scientifically justified and clinically appropriate, biomonitoring should investigate oxidative stress, inflammatory processes, endocrine alterations and other biological parameters identified in experimental RF research.

These measurements should be used as research tools unless their validity as indicators of RF-related injury has been scientifically established.

Adverse event reporting

Healthcare professionals and members of the public should have access to a dedicated national reporting system for symptoms and illnesses suspected to be associated with electromagnetic exposure.

Reports should be systematically recorded, assessed and, where appropriate, investigated through clinical evaluation and independent exposure measurements. **Patients must not be required to establish causation before their reports can be submitted or considered for investigation.**

Accountability and the social costs of telecommunications infrastructure

AMICA APS considers that epidemiological surveillance must also serve a broader public interest: identifying the potential health, social and economic costs associated with telecommunications-related environmental exposure.

If independent scientific investigations establish that particular exposures contribute to disease or environmental damage, the resulting costs must not fall exclusively upon affected individuals, their families and publicly funded healthcare systems.

Telecommunications companies should be held financially accountable for health and environmental damage scientifically attributable to their activities, in accordance with applicable law. Such accountability should include medical treatment, rehabilitation, disability-related support, environmental remediation and other demonstrable consequences.

AMICA therefore calls for an independent mechanism to assess the health and economic burden of telecommunications-related exposures, establish responsibility where supported by evidence and ensure that the costs of proven harm are borne by the responsible operators.

The telecommunications industry should also contribute to financing independent environmental monitoring and public health surveillance through mandatory regulatory fees. Such financing must not confer any influence over research priorities, scientific methods, data interpretation or publication of results.

The profits generated by wireless infrastructure must not be privatised while the costs of any resulting harm are transferred to patients and public healthcare systems.

Question 11 — Should exposure or risk assessment be differentiated for sensitive populations?

AMICA APS considers that exposure and risk assessments must explicitly account for differences in biological vulnerability, age, health status, exposure duration and the ability to avoid involuntary exposure.

A single exposure limit cannot be presumed to provide adequate protection for every population group, particularly when existing standards are based predominantly on the prevention of established thermal effects.

Children. Children require particular protection because of their developing nervous systems, anatomical and physiological characteristics, and the prospect of cumulative exposure throughout their lives. Wireless infrastructure in or near schools should be subject to independent exposure assessments, and wired communication systems should be prioritised in educational environments.

Pregnant women. Prenatal development involves complex biological processes that may be vulnerable to environmental disturbances. Risk assessments should explicitly consider maternal and fetal exposure rather than assuming that standards developed primarily around adult exposure adequately address prenatal susceptibility.

Older adults. Older people may have chronic illnesses, reduced physiological resilience and prolonged exposure in residential or healthcare environments. Particular attention should be given to hospitals, residential care facilities and long-term exposure conditions.

People with implanted medical devices. Exposure assessments must address electromagnetic compatibility and potential interference with pacemakers, implanted defibrillators, neurostimulators and other electronic medical devices. These risks require device-specific evaluation and should not be confused with the biological effects investigated in RF toxicology.

Occupationally exposed workers. Workers involved in telecommunications and other RF-related activities may experience repeated exposure at levels exceeding those encountered by the general population. Occupational protection should include personal exposure monitoring, documented exposure histories, appropriate medical surveillance and independent workplace assessments. Employment must not be interpreted as consent to avoidable health risks.

People with pre-existing medical conditions. Individuals with neurological, cardiovascular, immune-related or other chronic illnesses should not automatically be assumed to have the same susceptibility as healthy adults. Where evidence remains incomplete, reasonable exposure-reduction measures should be available.

People with Electromagnetic Hypersensitivity (EHS). AMICA APS considers that individuals affected by EHS require particular attention from healthcare institutions and public authorities.

Many report severe symptoms and substantial functional limitations that interfere with their ability to live, work, travel and access essential services in environments containing wireless transmitting equipment.

Although the causal mechanisms underlying EHS remain scientifically disputed, uncertainty concerning those mechanisms must not justify dismissing patients' symptoms or denying appropriate medical care and reasonable environmental accommodations**.**

AMICA therefore calls for access to low-exposure environments, wired communication alternatives, suitably adapted healthcare facilities and practical measures to reduce involuntary exposure. Affected individuals should not be required to demonstrate a universally accepted biological mechanism before their functional limitations and accommodation needs are considered.

Immediate regulatory action: reducing public exposure limits to 0.6 V/m

Improved research and epidemiological surveillance must not become reasons to postpone preventive action. AMICA APS calls upon United States federal authorities to establish an immediate precautionary public exposure limit of **0.6 V/m**, with particular priority given to homes, schools, hospitals, residential care facilities and other environments occupied for prolonged periods.

This proposal is supported as a precautionary policy objective by Resolution 1815 (2011) of the Parliamentary Assembly of the Council of Europe (PACE), *The potential dangers of electromagnetic fields and their effect on the environment*.

Paragraph 8.2.1 recommends preventive thresholds for long-term exposure to microwaves in indoor areas, not exceeding **0.6 V/m**, with a progressive reduction towards **0.2 V/m** in the medium term.

These values are precautionary policy recommendations, not experimentally established thresholds guaranteeing the absence of biological effects. Nor do they constitute binding international exposure standards.

Nevertheless, they provide a concrete basis for a more protective regulatory approach to chronic, involuntary exposure.

AMICA calls for the adoption of 0.6 V/m as an enforceable precautionary limit for long-term public exposure, accompanied by a progressive reduction towards 0.2 V/m, independent environmental monitoring and mandatory epidemiological surveillance.

Implementation should require telecommunications operators to reduce avoidable emissions, adopt less-exposing technical solutions and demonstrate compliance through independently verified measurements. Exposure assessments should consider the combined contribution of relevant RF sources rather than evaluating each installation in isolation.

Public health protection cannot depend exclusively on voluntary emission reductions by telecommunications companies.

The fundamental principle must be that technological development serves human health and environmental protection, rather than requiring populations to accept increasing involuntary exposure without adequate independent assessment of its consequences.

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Question 12 — What scientific evidence exists regarding potential adverse health effects associated with radiofrequency exposure below current federal limits?

AMICA APS considers that the scientific evidence accumulated over several decades challenges the assumption that radiofrequency electromagnetic fields are biologically harmless whenever exposure remains below existing federal limits.

The central scientific issue is not simply how much electromagnetic energy is absorbed by the body, but also how exposure varies over time. **Signal pulsation, modulation, pulse repetition rates and induced electric fields are potentially relevant parameters that must be adequately characterised in biological research and risk assessment.**

Current RF exposure standards focus predominantly on preventing established adverse effects associated with tissue heating. However, experimental studies have reported biological alterations under exposure conditions that do not produce appreciable heating.

Lai and Singh (1995, 1996) reported single- and double-strand DNA breaks in brain cells of rats exposed to radiofrequency electromagnetic fields. Marinelli and colleagues (2004) investigated alterations in apoptotic and cell-survival signalling following exposure to 900 MHz electromagnetic fields. Other experimental investigations have examined oxidative stress, enzyme activity, calcium signalling and cellular regulatory mechanisms.

Particular attention should be given to the work of Martin L. Pall (2013), who proposed that electromagnetic fields may influence voltage-gated calcium channels (VGCCs), potentially initiating biochemical responses involving intracellular calcium, nitric oxide, peroxynitrite and oxidative stress.

Although the relevance of this proposed mechanism to human health outcomes under environmental RF exposure remains scientifically contested, it illustrates why the absence of measurable tissue heating cannot, by itself, establish biological inactivity.

AMICA therefore urges federal health agencies to reassess the scientific evidence concerning biological effects below current exposure limits, with particular attention to non-thermal mechanisms and the potential influence of signal pulsation and modulation.

Pulsation as a determinant of biological response

A fundamental distinction must be made between the carrier frequency of an electromagnetic field and the temporal characteristics of the transmitted signal.

Radar systems, Wi-Fi equipment and mobile telecommunications networks generate signals with different patterns of pulsation, modulation and intermittent transmission. These characteristics may influence biological responses independently of average exposure intensity.

Belyaev (2005) reviewed experimental evidence indicating that biological responses to microwaves depend not only on power density but also on signal characteristics.

The Scientific Resolution of Potenza Picena (20 April 2013), adopted following the international conference *Radar, Radiofrequencies and Health Risks*, specifically addressed the biological significance of pulsed radiofrequency exposure. Its signatories, including Henry Lai, Fiorenzo Marinelli, Olle Johansson and Nesrin Seyhan, concluded that pulsed radar emissions may produce biological effects that differ from those associated with non-pulsed fields.

The Resolution highlighted potential alterations in enzyme activity and DNA regulation, including genomic methylation, and reported experimental observations in cultured cells exposed to radar emissions in residential areas of Potenza Picena. These observations included activation of apoptosis following short-term exposure and pro-survival signalling after exposure exceeding 24 hours.

The Resolution called upon governments and public health authorities to revise exposure standards to account for the biological effects of pulsed radiofrequency signals, including effects occurring below levels associated with thermal injury.

Pulsation matters. The biological effects of an electromagnetic signal cannot be adequately assessed from its time-averaged power alone. This does not establish that every pulsed signal is harmful, but it requires pulse characteristics to be investigated rather than excluded from risk assessment.

AMICA APS therefore urges federal health agencies to **require explicit characterisation of pulsation, modulation, peak intensity, pulse repetition frequency and exposure duration** in experimental studies and regulatory assessments, rather than relying predominantly on average power density or SAR values.

Evidence from residential exposure to mobile telephone base stations

Epidemiological investigations involving populations living near mobile telephone base stations have reported associations with adverse health outcomes at environmental exposure levels below existing regulatory limits.

Hutter and colleagues (2006) investigated residents exposed to emissions from mobile telephone base stations in urban and rural environments. Although measured exposure levels were substantially below prevailing reference limits, the researchers reported associations between RF exposure and certain subjective symptoms, particularly headaches.

Abdel-Rassoul and colleagues (2007) reported increased frequencies of neurobehavioural symptoms among residents living near mobile telephone base stations compared with a control population.

Eger and colleagues (2004) and Wolf and Wolf (2004) reported increased cancer incidence among populations residing near telecommunications installations. However, limitations in study design, exposure assessment and control of confounding factors restrict the conclusions that can be drawn concerning causation.

Balmori (2022), reviewing research on populations living near mobile telephone base stations, identified studies reporting symptoms, biological alterations and cancer-related outcomes associated with residential exposure.

Although these investigations differ in methodological quality and do not independently establish causal relationships, **their findings warrant systematic epidemiological investigation and precautionary consideration, particularly because the reported associations occurred under exposure conditions generally regarded as compliant with existing limits.**

AMICA urges federal health agencies to conduct independent studies incorporating objective exposure measurements, long-term residential histories and appropriate comparison populations. **Compliance with existing exposure limits must not be used as a reason to exclude potentially relevant epidemiological findings from public health risk assessments.**

Experimental evidence of carcinogenicity

The United States National Toxicology Program (NTP, 2018) reported clear evidence of carcinogenic activity in male rats exposed to GSM- and CDMA-modulated radiofrequency radiation, principally based on malignant schwannomas of the heart.

Falcioni and colleagues (2018), in the Ramazzini Institute study, reported a statistically significant increase in heart schwannomas among male rats exposed to a 1.8 GHz GSM signal at 50 V/m, below the ICNIRP reference level applicable at that frequency.

The Ramazzini findings are particularly relevant because the investigation examined long-term, far-field exposure representative of emissions from mobile telephone base stations. The occurrence of related tumour types in two independent experimental programmes strengthens the evidence warranting reassessment of RF carcinogenic hazards.

These studies challenge the assumption that compliance with existing standards is sufficient to exclude long-term carcinogenic hazards.

AMICA APS therefore calls for an immediate, independent reassessment of federal RF exposure limits, incorporating experimental carcinogenicity, chronic exposure, non-thermal biological effects, signal pulsation and modulation, and the vulnerability of specific population groups.

Question 13 — According to scientific evidence, how do emerging and existing wireless technologies affect cumulative exposure patterns?

AMICA APS considers that the expansion of wireless technologies is transforming the electromagnetic environment through the proliferation of transmitting sources, frequency bands, modulation schemes and patterns of intermittent exposure.

The fundamental issue is not simply the increasing number of wireless devices, but the simultaneous presence of electromagnetic signals with different frequencies, pulse structures, transmission cycles and spatial distributions.

Cumulative exposure assessments must characterise the combined contribution of relevant RF sources, including their temporal variations, peak intensities, pulsation and modulation, rather than relying exclusively on isolated measurements or time-averaged power density.

The biological consequences of simultaneous exposure to multiple signals remain insufficiently characterised. Whether different exposure conditions produce additive, synergistic or other biological responses must be investigated experimentally rather than inferred solely from conventional power measurements.

AMICA therefore urges federal health agencies to develop standardised methodologies for assessing real-world exposure from multiple wireless technologies and to support independent research into the potential biological significance of combined and prolonged exposure.

a. Fifth-generation mobile networks (5G)

The deployment of fifth-generation mobile networks raises significant public health concerns, both because of the biological evidence associated with radiofrequencies already used by previous generations of wireless technology and because of the substantial scientific uncertainties surrounding newer, higher-frequency applications.

5G introduces technical characteristics that complicate exposure assessment, including multiple frequency bands, massive multiple-input multiple-output (MIMO) antenna systems, beamforming, dynamic transmission patterns and, in some deployments, dense networks of small cells. Beamforming produces spatially and temporally variable emissions that cannot always be adequately characterised through static measurements or conventional time-averaged exposure metrics.

A major scientific assessment commissioned by the European Parliament provides substantial grounds for concern. In *Health impact of 5G*, Belpoggi (2021) reviewed epidemiological and experimental evidence concerning carcinogenicity and reproductive and developmental effects of radiofrequency electromagnetic fields.

For frequencies between 450 MHz and 6 GHz, encompassing bands used by 5G and previous mobile telecommunications generations, the review identified **limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals**. Integrating these findings, Belpoggi concluded that radiofrequency electromagnetic fields in this frequency range should be regarded as probably carcinogenic to humans.

The assessment also identified sufficient evidence of adverse effects on male fertility in both human epidemiological studies and experimental animal investigations, together with evidence raising concerns about female fertility and prenatal development.

These conclusions are particularly relevant because 5G operates alongside existing telecommunications networks, contributing to an increasingly complex environment of simultaneous and prolonged radiofrequency exposure.

For higher frequencies between 24 and 100 GHz, the review identified no adequate studies capable of assessing carcinogenicity or reproductive and developmental hazards. The absence of adequate evidence is not evidence of safety, particularly when these frequencies are being considered for widespread commercial applications.

At millimetre-wave frequencies, electromagnetic energy is absorbed predominantly in superficial tissues, making the skin and other exposed surfaces important targets for independent dosimetric and biological investigations. Research by Feldman and colleagues has explored how anatomical structures within the skin may influence electromagnetic interactions at these frequencies.

Belpoggi (2021) also identified important uncertainties concerning the assessment of exposure from dynamically operating 5G networks and recommended consideration of a moratorium on millimetre-wave deployment pending adequate research.

AMICA supported the call for a precautionary moratorium on the further deployment of 5G, promoted by a group of scientists led by Professors Rainer Nyberg and Lennart Hardell in 2017: https://www.5gappeal.eu/

The appeal and the institutional responses to it were subsequently discussed in a peer-reviewed scientific publication:

Hardell, L., & Nyberg, R. (2020). Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation. *Molecular and Clinical Oncology*, 12(3), 247–257. https://doi.org/10.3892/mco.2020.1984

AMICA APS considers that the deployment of new 5G technologies must not proceed on the assumption of safety when significant carcinogenic, reproductive and developmental concerns have been identified at lower frequencies and adequate investigations remain lacking at higher frequencies.

AMICA therefore urges federal health agencies to require independent pre-deployment assessments of new 5G frequency bands and transmission systems, including carcinogenicity, reproductive and developmental toxicity, chronic exposure, signal pulsation and modulation, beamforming, peak intensity and cumulative exposure from multiple transmitting sources.

b. Sixth-generation mobile networks (6G)

The development of sixth-generation mobile networks raises additional concerns about the introduction of new sources and patterns of involuntary radiofrequency exposure before their long-term biological consequences have been adequately investigated.

Proposed 6G systems may incorporate additional frequency bands, potentially extending into sub-terahertz ranges, increasingly complex antenna architectures, highly dynamic transmission patterns and greater integration between terrestrial and satellite communication networks.

Although final technical specifications and deployment scenarios remain under development, these innovations could introduce exposure conditions that differ substantially from those investigated for previous wireless generations.

AMICA APS considers that the scientific uncertainties already identified in relation to 5G must not be reproduced or amplified with 6G. New frequency bands, modulation schemes and transmission technologies should undergo independent biological and environmental safety assessments before commercial deployment.

Such assessments should investigate chronic exposure, potential carcinogenicity, reproductive and developmental toxicity, signal pulsation and modulation, peak intensities and cumulative exposure from multiple sources.

AMICA calls for a precautionary moratorium on the commercial deployment of 6G systems until adequate independent pre-market safety investigations have been completed and enforceable exposure limits have been established.

The absence of adequate evidence of harm must not be interpreted as proof of safety, nor should compliance with standards developed for earlier wireless generations automatically establish the safety of new technologies.

c. Wi-Fi

Wi-Fi is a significant source of involuntary environmental RF exposure because of its widespread presence in homes, schools, workplaces, public transport and healthcare facilities.

Wi-Fi systems employ intermittent packet transmission, producing time-varying emissions whose temporal characteristics depend on network activity, communication protocols and device configuration. Exposure assessment should therefore consider signal pulsation, modulation, transmission patterns and peak intensity, rather than relying exclusively on average field strength.

Cappucci and colleagues (2022) reported alterations in transposable element regulation and genomic stability in *Drosophila melanogaster* following experimental exposure to Wi-Fi-related radiofrequency electromagnetic fields.

Although these experimental findings require independent replication and cannot be directly extrapolated to human health outcomes, they raise questions concerning potential biological responses that warrant further investigation.

AMICA APS urges federal health agencies to promote the replacement of Wi-Fi with wired Ethernet connections wherever practicable, particularly in schools, hospitals, residential care facilities and environments occupied by children or individuals with Electromagnetic Hypersensitivity.

Wired communication infrastructure should be prioritised in public buildings and educational facilities as a practical precautionary measure to reduce avoidable RF exposure without compromising access to digital services.

d. Satellite communications

The expansion of commercial satellite constellations represents another step towards the continuous multiplication of radiofrequency sources in an electromagnetic environment already saturated with wireless transmissions.

The concern is not limited to emissions from satellites themselves, but extends to the terrestrial infrastructure required for their operation, including gateway stations, transmitting user terminals and associated wireless networks.

Existing experimental evidence of RF-related DNA damage, oxidative stress and alterations in cellular regulation provides sufficient grounds for opposing the unrestricted expansion of new radiofrequency-emitting infrastructure. It is no longer scientifically reasonable to treat each new technology as an isolated source whose safety can be inferred merely from compliance with existing thermal exposure limits.

The introduction of additional frequencies and transmitting systems also raises questions about the combined biological effects of simultaneous exposures, including possible additive or synergistic interactions that conventional compliance assessments are not designed to resolve.

AMICA APS therefore calls for a moratorium on further large-scale deployment of commercial satellite communication infrastructure until independent assessments have established adequate protection against cumulative exposure and enforceable precautionary limits have been adopted.

e. Internet of Things (IoT)

The Internet of Things contributes to the progressive densification of the electromagnetic environment through the proliferation of wireless sensors, appliances, communication modules and automated devices.

Although individual transmitters may operate at relatively low power, their widespread deployment introduces additional frequencies, repeated transmissions and overlapping exposure patterns into environments where people already experience continuous or recurrent RF exposure.

The experimental evidence of genetic and cellular alterations associated with RF exposure makes the unrestricted multiplication of wireless transmitters an unacceptable precautionary policy. Evaluating each device separately cannot establish the biological safety of the combined exposure environment.

Potential additive and synergistic effects between different signals must be investigated, rather than disregarded because individual devices comply with existing limits.

AMICA calls for a halt to the unnecessary expansion of wireless IoT infrastructure and for the mandatory adoption of wired alternatives wherever technically feasible.

f. Wearable technologies

Wearable technologies raise particular concerns because they introduce repeated or prolonged radiofrequency exposure in close proximity to biological tissues.

Bluetooth, Wi-Fi and cellular transmitters may operate near the skin and other tissues for extended periods, while users are simultaneously exposed to numerous additional environmental RF sources.

Given the experimental evidence concerning DNA damage, oxidative stress and alterations in cellular signalling, **the introduction of further RF-emitting devices designed for continuous bodily contact cannot be justified solely by demonstrating compliance with existing exposure limits**.

The potential consequences of prolonged near-body exposure, including interactions with other environmental signals, require independent biological investigation.

AMICA urges federal authorities to restrict the introduction of unnecessary wireless wearable technologies, particularly those intended for children, and to require independent pre-market safety assessments before authorising new exposure-generating applications.

g. Smart homes and connected household appliances

Smart homes can introduce numerous wireless transmitters into the very environments where people spend the greatest proportion of their lives, including bedrooms and other spaces occupied for prolonged periods.

Routers, smart meters, security cameras, thermostats and connected appliances may generate overlapping transmissions throughout the day and night, even when their wireless functions are not actively needed.

The existing evidence of RF-related genetic and cellular effects provides a compelling reason to prevent the further densification of residential

electromagnetic environments. The biological implications of simultaneous exposure to multiple signals cannot be adequately assessed by examining each appliance separately.

The possibility of additive or synergistic biological responses reinforces the need to reduce unnecessary sources rather than continuously introduce new ones.

AMICA calls for fully wired home automation systems, mandatory options to disable wireless transmissions and a prohibition on making wireless connectivity compulsory where technically viable alternatives exist.

h. Smart cities

Smart-city projects risk transforming residential neighbourhoods and public spaces into environments containing increasingly dense networks of wireless sensors, smart meters, surveillance equipment, telecommunications antennas and automated communication systems.

The fundamental public health concern is the progressive accumulation of radiofrequency sources, operating at different frequencies and with different patterns of pulsation and modulation, in areas where exposure is largely involuntary.

Experimental findings concerning DNA damage, oxidative stress and cellular dysregulation already provide grounds for rejecting the assumption that the continuous addition of wireless infrastructure is biologically harmless.

Moreover, the potential for additive or synergistic effects from simultaneous exposure to multiple signals remains insufficiently investigated. Compliance assessments conducted separately for individual installations cannot resolve this question.

AMICA APS therefore calls for a moratorium on further large-scale wireless smart-city deployments, the prioritisation of wired infrastructure and independent assessments of cumulative exposure before any additional RF-emitting systems are authorised.

Public authorities should pursue technological innovation by reducing unnecessary electromagnetic emissions, not by continuously increasing the number of transmitting sources to which populations are involuntarily exposed.

i. Autonomous vehicles

Autonomous and connected vehicles introduce additional radiofrequency sources through automotive radar, cellular communications, Wi-Fi, Bluetooth and vehicle-to-everything communication systems.

Automotive radar, including systems operating around 77 GHz, employs transmission characteristics that differ from those of conventional mobile telecommunications and require specific biological investigation.

The widespread introduction of such systems could add further RF exposure sources to roads, residential neighbourhoods and densely populated urban environments, affecting not only vehicle occupants but also pedestrians, cyclists and nearby residents.

Given the experimental evidence of genetic and cellular alterations associated with RF exposure, AMICA considers that the introduction of new radiofrequency-emitting technologies cannot continue without first demonstrating their biological safety under realistic conditions of use.

Particular concern arises from the simultaneous operation of numerous transmitting systems, whose potential combined and synergistic biological effects have not been adequately characterised.

AMICA therefore calls for a moratorium on the large-scale introduction of new RF-emitting automotive systems until independent biological safety investigations have been completed and enforceable precautionary exposure limits established.

Technological development should prioritise solutions that minimise additional electromagnetic emissions rather than further densifying an already complex exposure environment.

j. Wireless medical devices

The increasing use of wireless technologies in healthcare raises a fundamental contradiction: **medical institutions are introducing additional radiofrequency emissions into environments whose primary purpose is to protect health, including the health of patients who may be particularly vulnerable to environmental exposures.**

Experimental studies have reported RF-associated genetic damage, oxidative stress and alterations in cellular regulation. Against this background, the routine

introduction of wireless communication systems into hospitals, clinics and medical devices cannot be regarded as automatically safe merely because their emissions comply with existing exposure limits.

The use of radiofrequency-emitting equipment for routine data transmission is especially difficult to justify when clinically equivalent wired systems are available. **There is no medical necessity to expose patients to avoidable wireless emissions simply to transmit information that could be carried through a cable.**

Particular attention must be given to implanted devices, wearable monitoring systems, bedside equipment and wireless infrastructure in hospital wards. Electromagnetic compatibility with implanted medical devices must also be evaluated, although interference risks are distinct from the question of biological effects.

AMICA APS calls for healthcare facilities to prioritise wired medical monitoring and communication systems, minimise unnecessary wireless transmissions and provide low-exposure clinical environments for patients with electromagnetic hypersensitivity.

Healthcare innovation must not create avoidable environmental exposures in the very places where people seek protection from illness.

k. Wireless smart meters

Wireless smart meters represent a particularly serious concern because they introduce radiofrequency transmitters into residential environments, frequently without meaningful consent or control by the occupants.

Depending on their communication technology, these devices may emit repeated bursts of RF radiation, including transmissions occurring independently of household activity. Their biological relevance cannot be determined solely from low time-averaged power measurements, which may obscure peak emissions and temporal transmission characteristics.

AMICA APS has received reports from individuals who experienced the onset of symptoms consistent with electromagnetic hypersensitivity following the installation or activation of wireless smart meters. In the association's experience, these installations can coincide with the emergence of previously unreported symptoms, sometimes requiring affected individuals to seek substantial changes to their living environment.

These observations are consistent with concerns raised in an Australian case series by Lamech (2014), which documented self-reported symptoms following the installation of wireless smart meters in Victoria, Australia. The study described a range of neurological and other symptoms reported by affected residents, drawing attention to the potential consequences of introducing new RF sources into domestic environments.

Although this observational evidence does not independently establish causation, **it must not be dismissed simply because the devices comply with existing exposure standards**. The temporal relationship reported by affected individuals warrants independent clinical investigation, objective exposure measurements and appropriate public health surveillance.

The existing experimental evidence concerning RF-associated genetic and cellular alterations provides additional grounds for precaution, particularly where new transmitting equipment is installed close to bedrooms or other spaces occupied for prolonged periods.

AMICA considers it unacceptable to impose additional radiofrequency exposure in private homes when the same essential metering functions can be performed through wired technologies.

No household should be compelled to accept a potentially avoidable environmental exposure as a condition of receiving essential utility services.

Overall assessment of cumulative exposure

Across these technologies, the principal concern is the multiplication of electromagnetic sources and increasingly complex patterns of exposure.

Existing compliance assessments generally do not establish whether combinations of differently modulated signals produce biological responses that differ from those observed under single-source experimental conditions.

Pulsation and modulation must become central parameters of exposure assessment, alongside frequency, field strength, absorbed energy and exposure duration.

The health implications of combined exposure require investigation, but the lack of complete knowledge cannot justify ignoring these characteristics in regulatory evaluations.

Question 14 — What scientific evidence exists regarding potential adverse environmental effects associated with radiofrequency exposure?

Scientific evidence from field observations and experimental studies raises substantial concerns about the effects of anthropogenic electromagnetic fields on wildlife and ecosystems. Reported effects include changes in animal behaviour, reproduction, development, survival, cellular regulation and orientation. Although the strength of the evidence varies across species and exposure conditions, these findings provide grounds for precautionary environmental protection rather than the continued expansion of wireless infrastructure without adequate ecological assessment.

AMICA APS considers that environmental protection has been neglected in the development of radiofrequency exposure standards. The progressive introduction of new frequencies, transmitting systems and wireless infrastructure is altering the electromagnetic environment of organisms that evolved under substantially different exposure conditions.

The existing experimental evidence of RF-associated genetic and cellular alterations reinforces concerns about the cumulative consequences of this expansion. In particular, potential additive or synergistic biological effects arising from simultaneous exposure to multiple signals remain insufficiently investigated.

AMICA considers that the continued densification of the electromagnetic environment cannot be justified by evaluating each new transmitter separately against exposure limits developed primarily to protect humans from established thermal hazards.

Birds: population changes, reproduction and orientation

Balmori and Hallberg (2007) investigated the decline of house sparrows (*Passer domesticus*) in Valladolid, Spain, reporting an association between electromagnetic field intensity and sparrow abundance.

Everaert and Bauwens (2007) similarly reported lower densities of breeding house sparrows in Belgian residential areas with higher measured radiofrequency field strengths associated with mobile telephone base stations.

These findings raise concerns about possible ecological effects, although observational associations do not establish causation and other environmental pressures on bird populations must also be considered.

Engels and colleagues (2014) experimentally demonstrated that anthropogenic electromagnetic noise can disrupt magnetic compass orientation in migratory birds. This finding establishes that artificial electromagnetic disturbances can interfere with a biologically important sensory mechanism. However, the frequency characteristics of the interference investigated in that study differ from those of conventional mobile telecommunications and must not be treated as equivalent.

Taken together, these investigations support the inclusion of bird behaviour, nesting, reproductive success, orientation and population trends in environmental assessments of telecommunications infrastructure.

AMICA calls for independent ecological investigations before additional wireless infrastructure is installed in important breeding habitats, migration corridors and protected natural areas.

Pollinating insects and other invertebrates

Pollinating insects are essential to biodiversity, food production and the reproduction of flowering plants. Evidence suggesting that electromagnetic exposure may affect insect behaviour, reproduction or cellular processes therefore warrants particular attention.

Sharma and Kumar (2010) reported changes in honeybee behaviour and colony-related biological parameters under experimental exposure to mobile telephone radiation.

Panagopoulos and colleagues (2004) reported reduced reproductive capacity in *Drosophila melanogaster* exposed to GSM mobile telephone radiation.

Cappucci and colleagues (2022) reported alterations in transposable element regulation and genomic stability in *Drosophila melanogaster* following exposure to Wi-Fi-related radiofrequency fields.

Although these studies involve different species, experimental conditions and endpoints, **they provide evidence of biological responses that cannot be dismissed merely because the exposure levels or signal characteristics fall within conventional regulatory assumptions**.

The findings concerning genomic regulation are particularly relevant to the need for further investigation of possible non-thermal mechanisms.

AMICA calls for independent, long-term monitoring of pollinator populations and controlled experimental investigations using realistic wireless signals, including their modulation, pulsation and temporal characteristics.

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AMICA APS — Response to the HHS Request for Information

Docket No. HHS–OASH–2026–0397

Federal Research Priorities

Question 16 — What are the most significant research gaps concerning electromagnetic fields, radiofrequency radiation, and public health that federal health agencies should prioritise?

AMICA APS considers that the principal deficiency in federal radiofrequency research is not the absence of scientific evidence, but **the failure to translate existing evidence of biological effects into effective public health protection**.

Experimental and epidemiological studies have reported DNA damage, oxidative stress, alterations in cellular signalling, reproductive and neurological effects, and findings relevant to carcinogenicity. Nevertheless, current exposure standards remain predominantly focused on preventing established thermal effects.

The immediate priority must be to reassess existing evidence and strengthen regulatory protection, rather than postpone action pending further research.

A critical research gap concerns the biological effects of pulsed and modulated RF signals. Conventional exposure metrics, including average power density and specific absorption rate (SAR), do not fully characterise pulse duration, repetition frequency, modulation and peak intensity.

Belyaev (2005) reviewed evidence concerning non-thermal biological effects, while Pall (2013) proposed voltage-gated calcium channel activation as a possible mechanism. Although this mechanism requires further investigation, these findings support research beyond conventional thermal models.

Pulsation and modulation must become central parameters in biological safety assessments. Federal agencies should prioritise controlled comparisons of continuous-wave and pulsed signals, examining DNA integrity, oxidative stress, cellular signalling and reproductive effects.

Carcinogenicity also requires urgent regulatory reassessment. The National Toxicology Program (2018) reported clear evidence of carcinogenic activity in male rats, while Falcioni and colleagues (2018) reported increased heart schwannomas in male rats exposed to radiofrequency fields representative of mobile telephone base station emissions.

Federal agencies should also establish permanent epidemiological surveillance programmes integrating independent environmental measurements, residential exposure histories, disease registries and longitudinal health data, with particular attention to children, pregnant women, people with chronic illnesses and individuals with electromagnetic hypersensitivity.

Research must support prevention, not become a justification for indefinitely postponing precautionary measures.

Question 17 — How can federal health agencies improve the coordination of research on electromagnetic fields and radiofrequency radiation?

AMICA APS calls for an integrated federal research and regulatory framework coordinated by independent public health institutions, with clear responsibilities for biological safety assessment, environmental monitoring and population health surveillance.

a. Food and Drug Administration (FDA): Applying pharmaceutical safety principles to wireless technologies

The Food and Drug Administration (FDA) should play a central scientific role by applying principles comparable in rigour to those used in pharmaceutical safety assessment.

Before authorisation, pharmaceutical products undergo systematic evaluation of toxicity, biological effects and potential risks. By contrast, wireless technologies have been deployed on a massive scale, exposing populations involuntarily without equivalent independent pre-market investigations of long-term biological safety.

AMICA considers this regulatory disparity unacceptable. Technologies capable of producing biologically relevant exposures should be subject to preventive safety assessment before widespread deployment.

This does not require classifying wireless devices as medicines. It requires applying comparable principles: independent toxicological testing, evaluation of vulnerable populations, long-term studies, post-market surveillance and manufacturer accountability.

The FDA should lead the development of biological testing protocols addressing DNA damage, oxidative stress, neurological and reproductive effects, carcinogenicity, pulsation, modulation and cumulative exposure.

Compliance with limits designed primarily to prevent established thermal effects must not be treated as proof of biological safety.

AMICA calls for restrictions on unnecessary wireless emissions, particularly in schools, childcare facilities and hospitals, where wired alternatives should be prioritised. Wireless systems that are clinically necessary should undergo appropriate safety assessment.

AMICA also urges the immediate adoption of a precautionary long-term public exposure target of **0.6 V/m**, progressing towards **0.2 V/m**, drawing on Parliamentary Assembly of the Council of Europe Resolution 1815 (2011), which recommended these values for long-term indoor exposure.

These values are precautionary policy objectives, not experimentally established thresholds guaranteeing the absence of biological effects.

Manufacturers should bear the responsibility for demonstrating adequate safety before introducing technologies that increase involuntary population exposure. Federal research coordination must serve this preventive objective rather than merely document risks after widespread deployment.

b. National Institutes of Health (NIH): Independent biological and toxicological research

The NIH should coordinate independent research into the biological mechanisms and long-term health consequences of radiofrequency exposure, ensuring freedom from relevant industry conflicts of interest, transparent exposure characterisation and independent replication.

Priority must be given to the biological effects of pulsation and modulation, including controlled comparisons of different waveforms at equivalent average exposure levels. Investigations should examine DNA integrity, oxidative stress, cellular signalling, reproductive effects and other relevant biological endpoints.

The NIH should also pursue independent research addressing the carcinogenicity findings of the National Toxicology Program and the Ramazzini Institute, together with chronic and prenatal exposure and risks to vulnerable populations.

Further research must not be used to postpone precautionary measures already justified by existing scientific concerns.

c. Centers for Disease Control and Prevention (CDC): Epidemiological surveillance and public health protection

The CDC should coordinate nationwide surveillance of environmental radiofrequency exposure, integrating independent measurements, disease registries, occupational health data and longitudinal epidemiological studies through state and local health authorities.

It should establish standardised procedures for investigating suspected disease clusters near telecommunications infrastructure and a national reporting system for suspected adverse health effects associated with electromagnetic exposure.

Particular attention must be given to people with Electromagnetic Hypersensitivity, including access to appropriate healthcare and practical environmental accommodations.

The CDC should publish regular reports on exposure trends, health outcomes and preventive recommendations.

Environmental monitoring and surveillance should be financed through mandatory telecommunications industry contributions, while scientific governance remains entirely independent. Where causation and legal responsibility are established, companies should bear the resulting healthcare and social costs.

An integrated federal framework

AMICA APS calls for a permanent interagency programme involving the FDA, NIH, CDC, Federal Communications Commission (FCC) and relevant environmental authorities.

The FDA should lead preventive biological safety assessment; the NIH should coordinate independent toxicological research; and the CDC should oversee epidemiological surveillance and public health protection. These are proposed responsibilities within a strengthened federal framework, rather than a description of existing statutory powers.

The FCC must not treat compliance with current exposure limits as conclusive proof of long-term biological safety without independent evaluation by federal health agencies.

All participating scientific bodies must be subject to stringent conflict-of-interest rules and full disclosure of relationships with regulated industries.

The fundamental principle must change: manufacturers should demonstrate adequate biological safety before introducing technologies that increase involuntary population exposure, rather than requiring affected populations to prove harm after deployment.

The United States applies rigorous preventive safety assessment to pharmaceutical products. AMICA urges the federal government to apply comparable scientific

principles to wireless technologies, including independent pre-market testing, protection of vulnerable populations and post-market surveillance.

The absence of significant tissue heating must no longer be accepted as sufficient evidence of biological safety.

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