



EUROPEAN COOPERATION IN THE FIELD OF SCIENTIFIC AND TECHNICAL RESEARCH
ACTION 281: POTENTIAL HEALTH IMPLICATIONS FROM MOBILE COMMUNICATION SYSTEMS

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Scientific Comment
on
Individual Statements of Concern About Health Hazards of Weak EMF

This report was agreed upon by the Steering Committee of COST Action 281
on November 2001

1 Introduction

The increasing use of mobile telecommunication devices and base stations has led to concerns among the general public about possible adverse health effects of their electromagnetic fields (EMF). A major reason for these concerns are contradictory results of scientific experiments and the interpretation given of these results by concerned members of the public and some scientists.

In response to a request by the Irish Department of Public Enterprise, to comment on a submission prepared by Dr. G. Hyland for the European Parliament the newly established COST action 281 on "Potential Health Implications from Mobile Communication Systems" (PHIMCOS)¹ has prepared this discussion paper in order to provide a balanced scientific view of the debate. In particular this reflects the concern that views have entered the public domain when they are not representative of the views of the leading scientists in this subject. Following COST action 281's stated objective to provide a basis for risk communication (see Annex 1) for decision makers, e.g. members of the European Parliament to provide them with the view of the scientific consensus in this subject from an acknowledged group of experts in this field.

COST action 281 is aware that Dr. Hyland is not an expert in the field of investigation and assessing biological EMF interaction although his work is supported by a company, which markets EMF protective devices. However, since many of his arguments and conclusions can also be found in the public domain they are discussed *inter alia* in this paper.

2 Commentary

Many critics like Dr. Hyland suggest that, ***"a major contemporary threat to the health of society is man-made 'electrosmog'"***².

This general statement is misleading for several reasons:

- By using the non-scientific term "electrosmog" it unscientifically brings together extremely low frequency (ELF) electric fields, magnetic fields and also radio frequency (RF) electromagnetic fields (EMF) irrespective of their frequency and amplitude. This neglects the fact that these three kinds of fields are very different, in terms of their physical nature as well as their biological interaction mechanisms.
- The statement ignores that the European Commission has already issued a recommendation to limit public exposure to non-ionising EMF to protect the health and well-being of the population. This recommendation properly accounts for the frequency-dependent differences of EMF and the different efficiencies of

¹ The COST (European Co-operation in the Field of Scientific and Technical Research) action 281 was established in September 2001 in order to obtain a better understanding of possible health impacts due to electromagnetic fields emitted by emerging technologies. By participation of 18 signatory countries and co-operation with international bodies like WHO and ICNIRP, COST 281 brings together the leading scientific experts in the field (see Annex).

² texts cited from Hyland's report of March 2001 on „The Physiological and Environmental Effects on Non-Ionising Electromagnetic Radiation“ to the Scientific and Technological Options Assessment (STOA) group of the European Parliament are written bold italics.

the self protection mechanisms of the human body like cellular excitation thresholds or heat tolerance. These differences are the reason why exposure limits are very different for the different kinds of fields as well as for different frequencies.

In general, the arguments brought forward by Dr. Hyland and others (e.g. Dr. N. Cherry³) suffer from:

- arbitrary postulates, which are based on individual belief rather than scientific evidence
- inconsistencies in argument,
- wrong facts,
- unbalanced, voluntary selection of those individual scientific papers which seem to support their pre-set opinion and
- misunderstanding and/ or misinterpretation of scientific papers.

Examples will be given for each of these different aspects.

2.1 Arbitrary postulates

It needs to be stressed, that plausibility is a necessary but by no means sufficient requirement for discussing a hypothesis. The pure fact, that a hypothesis can be imagined and seems to be plausible does not constitute a proof for its validity.

One of the basic postulates brought forward by Dr. Hyland is that **“humanity had not had enough time to develop evolutionary immunity against electrosmog”**.

This argument is frequently suggested, but it is highly speculative and philosophical rather than scientific.

- Without scientific support it is postulated that
 - a) evolutionary protection to EMF should have been needed and be expected and
 - b) that the time for this has been too short.

There is no scientific support for this view. In contrast, it neglects the basic evolutionary principle, which says that evolutionary adaptation, or protection is not developed to any external influences but only to those where this provides an advantage for survival of the species (rather than the individual). There are no scientific findings that this applies to “electrosmog” and there is no sound basis for such an assumption.

- In putting all the technological EMF into one “electrosmog”- pot it does not **distinguish** between ELF electric and magnetic fields or RF electromagnetic fields which not only differ in respect to their physical nature but also to their biological interaction principles.

Furthermore, It is argued that **“the highly coherent electromagnetic fields of technological origin”** would have **“frequency-specific influences of an informational nature” not taken into account by the existing limits.”**

This postulate

³ N. Cherry: “Criticism of the Proposal to Adopt The ICNIRP Guidelines for Cellsites in New Zealand“

- leaves unclear which **coherence criteria** are considered necessary for causing adverse health effects and
- ignores the usual stochastic amplitude and frequency changes in environmental EMF's of technological origin.

It is postulated by Dr. Hyland that GSM radiation affects the organism. This is supported by the argument GSM **“has certain rather well defined frequencies”** which can interfere with **“a variety of oscillatory electrical biological activities, each characterised by a particular frequency, some of which happen to be close to those used in GSM”**, in particular **8,34 Hz** and **2 Hz**, which **“correspond to those found in the human EEG- specifically in the ranges of the alpha and delta brain waves, respectively”**.

This is a non-scientific argument by analogy. It ignores the fact that

- the human EEG does not contain “well defined frequencies” but can be mathematically transformed into a continuous frequency spectrum with time-varying spectral centres of gravity.
- Besides this, the EEG is the result of a summation over the electric output of many thousands of individual nerve cells rather than the activity of a single cell. It can be seen as by-product of a running process comparable to the noise of an engine and does not have a biological function itself. In fact, the electrical signal of a single cell differs significantly from the EEG signal both in respect to frequency content and amplitude.
- Furthermore, the argument of the impact of weak EMF even with resonant frequencies ignores the fact that the human body itself contains very dominant electric noise generators like the heart, skeletal muscles and different brain regions which produce electric signals in similar frequency ranges. Therefore, our body continuously has to cope with self-generated interference problems.
- This is the reason, why the human organism has developed an interference self-protection. This self-protection is realised by non-linear responses to external stimuli and is reflected by the existence of excitation thresholds and the “all-or-nothing” excitation principle of biological cells. This means, that an electric stimulus can only be effective if its amplitude exceeds a certain minimal value and if so, that the cell excitation itself does not depend on the stimulus amplitude any more. Therefore, electric stimuli, irrespective of whether they are originating from an internal or external source, cannot become biological relevant if they stay well below the excitation threshold.
- Finally, biological cells are electrically shielded by submersion in a highly conductive extracellular fluid.

Therefore, postulating that weak GSM signals would affect brain activity just because there is a similarity in the frequency components ignores well-established knowledge.

To challenge the requirement for replication of results, Dr. Hyland argues that **“difficulties sometimes experienced in attempts to independently replicate certain frequency-specific non-thermal effects are actually to be expected”** since because of the **“highly non-linear, non-equilibrium nature of living systems even the slightest differences in the physiological state ... can, in consequence of deterministic chaos, assume singular importance”**.

It is known that biological systems are controlled by many non-linear processes that are far from equilibrium.

- However, as an inherent condition for survival and the result of evolution these processes do not endanger but ensure stability. This experience is well founded by the huge body of evidence gained in medical treatment of patients.
- There is no doubt that the difficulties in replicating EMF effects increase with decreasing amplitude but the reason is the decreasing significance of a possible effect as a consequence of a signal to (biological) noise ratio problem and the inter-individual variation of reactions.
- Therefore, the demand not only for replication of an effect but also for confirmation by independent groups is justified not only on theoretical grounds but also by many experiences made over the years where initial findings could later be explained by deficiencies in the course of investigation. The most recent example is the misinterpretation of changes of blood pressure readings due to mobile phone use which - in the end - after some confirming studies- was found to be the result of electromagnetic interference with the electronic blood pressure monitoring equipment employed in the tests.

Dr. Hyland (B4-6) concludes that ***“given that animals are often more highly electrosensitive than are humans, the serious nature of health problems they have manifested over such a relatively short period of time could ... constitute a valuable early- warning system, similar to the ‘canary down the mine’”***

It is well known that there are some species (like some fish and birds) that are able to sense changes in the steady geomagnetic or electric fields. To extend this finding over the EMF frequency range and to humans is highly speculative. It is not only just based on mainly anecdotal reports but, more strikingly ignores the huge body of animal studies carried out over decades which do not justify this expectation. Although not too important to his argument this indicates that major scientific rules, on which fundamental conclusions need to be based, are not observed.

2.2 Inconsistencies in argument

It is postulated that it would be ***“the “informational nature” rather than the energy that could cause harm.”***

This is a fundamental challenge to the existing exposure limits as it pretends that due to their “information” even very weak fields could have a biological impact. However, implicitly it is based on important requirements, namely, that

- a biological EMF-sensor exists at all;
- the sensor is susceptible to the enormous frequency range of electric, magnetic and electromagnetic fields of technical origin (“electrosmog”) or at least to specific EMF signals thereof;
- there exists a structure that is able to “understand” and react to the “information”.

Since in this argument the term **“information”** is not defined, it remains unclear whether it should be understood as “message” or “resonance”.

- If used as **“message”**, it is requisite that the EMF signal contains the message in an appropriate code or “language” that can be understood.
- If used as **“resonance”**, a resonance effect will need EMF signal constancy and a sufficiently long time to develop.

However, both hypothetical cases imply that weak field effects are based on signal- or frequency-specific interactions, which by their nature do not allow extrapolation to other

exposure situations. However, this consequence is frequently ignored by critics and by Dr. Hyland himself.

To support the warning against GSM fields effects are cited that were found at quite different frequencies (e.g. references /5/, /8/, /10/, /17/, /20/, /22/, /23/). This is in contradiction to Dr. Hyland's hypothesis of frequency- selective effects, which by its nature does not allow extrapolation to other frequencies.

Unjustified extrapolations are made by Dr. Hyland and others when extrapolating findings to different exposure situations, hence coming to wrong conclusions. An example of this ignorance is given when the importance of the "information" is derived by analogy from the fact that "**at certain modulation frequencies "flickering light can trigger seizures"** in some people except "**it is so low that it is not visible**".

There is no scientific basis for the argument that effects of visible electromagnetic radiation (light) could be extrapolated over many magnitudes of frequencies. In addition the argument neglects to consider that the cited effect requires two necessary preconditions to be met, namely that:

- there exist specific biologic (resonance) receptors necessary to react to this kind of EMF (light). However, no "electrosmog"- receptors could be found in humans.
- the light intensity needs to be high enough to exceed the perception threshold;
- the existing EMF limits do prevent from exposure above the perception threshold. Furthermore, in daily life exposure to "electrosmog" is usually several magnitudes below these limits.

In particular, Dr. Hyland is warning against the 17,6 Hz TETRA repetition rate because of its similarity with flickering light sensitivity. By doing this, he is ignoring the multistep sequence behind the visual light effect (above-threshold signal, perception by receptors, transmission to the brain, cortical processing).

2.3 Wrong facts

It is suggested that the existing limits do not protect against adverse health effects because the organism would be "**a biological counterpart of an electrically tuned circuit**" and that an "**undesirably high resonant amplification of or damaging interference with (tuned) endogenous biological activity**" could result.

Without citing scientific studies, as an example it is claimed that "**isolation from weak (natural) electromagnetic Schuman resonance fields has been found to damage human health**".

It needs to be pointed out that the hypothesis that extremely weak natural electric and/ or magnetic earth- ionosphere resonance fields could have a health impact had been formulated some 30 years ago. However, although attempts have been made it could never be proved. Therefore, to claim that such an adverse health effect had been found, clearly lacks scientific evidence.

It is claimed that "**there is a lack of expert consensus on the significance and credibility of research into biological effects of GSM-type radiation**".

This statement is polemic rather than fact.

- It leads to the question: Who is an expert (in the field of EMF research)? In fact, to have expertise needs

- at least specific fundamental scientific knowledge and familiarity with the scientific methodology and with problems and pitfalls of the specific research field.
- Besides this necessary requirement for being acknowledged as an expert it is a further requirement to be accepted by the (relevant) scientific community.

Most of the critics of the existing limits are self-declared or media-made “experts” who do not meet these criteria and substitute knowledge by faith.

- It is neither new nor surprising that scientific research was, is and will continue to be controversial. This is the reason why the body of scientific findings needs careful assessment and weighing of the pros and cons before deriving conclusions. Since no single expert can have all of the large variety of different expertise that EMF risk assessment requires, a multidisciplinary approach by a group of experts including physicians, biologists, biophysicists, technical engineers and (bio-) statisticians is needed. Therefore, on a national and international level there are several scientific bodies dealing with EMF risk assessment e.g. WHO, ICNIRP, COST 281, EBEA, NRPB, SSK⁴. Since these generally acknowledged scientific bodies have reached a wide consensus in their EMF risk assessment it is not justified and even misleading to claim that there is a lack of consensus among scientific experts.

Dr Hyland calls it **“an irony” that safety guidelines afford a greater protection to electronic instrumentation than they do to human beings.**”

This lay-people argument ignores the fact that different limits are the consequence of the fact that electronic instrumentation can be more susceptible to EMF when compared with humans. This has objective reasons:

- Electronic instrumentation is usually composed of antenna-like metallic structures which can receive electromagnetic signals more efficiently than biological objects;
- It frequently contains electronic amplifiers, which actively enhance weak EMF signals making electromagnetic disturbances electronically efficient well below biologic threshold levels.

These are the reasons why at mobile communication frequencies, for some devices, immunity levels can be lower than human exposure limits by approximately one order of magnitude.

2.4 Misunderstanding and misinterpretation

Like other “expert critics” Dr. Hyland cites the scientific literature wrongly, and/or incompletely. This is demonstrated by some examples:

- Dr. Hyland (B-2) reports that **“peak magnetic field strengths of 40 μ T”** have been measured near the back of a particular mobile phone and claims that this would be noxious, referring to two arbitrarily selected unpublished findings. However, irrespective of the credibility of the cited findings, it is fundamentally erroneous to compare a local spot value with a whole body exposure condition.

⁴ World Health Organisation (WHO), International Commission on Non-Ionising Radiation Protection (ICNIRP), European Cooperation in the Field of Scientific and Technical Research (COST), European BioElectromagnetic Association (EBEA), UK National Radiation Protection Board (NRPB), German Radiation Protection Commission (SSK)

- Many of cited effects were found at exposure conditions above the existing exposure limits (e.g. references /5/, /8/, /10/, /17/, /20/, /22/, /23/)
- Statistical significance is claimed for results where even the authors did not claim significance or where they were not able to replicate their own findings (e.g. references /44/, /46/, /48/).

Dr. Hyland argues that an ***“invaluable indicator for the potential noxiousness of the pulsed microwave fields emitted by base-stations is the increasing number of reports- some published, some as yet anecdotal (!) – of adverse effects on various animal species, specifically cattle, dogs, birds and bees.”***

As a reference he cites in conflict to his own hypothesis of the frequency selectiveness of weak field- only one study on radio-transmitting antenna at frequencies, which are not relevant to GSM (65). He ignores other studies, which did not find effects of EMF's but refers to several anecdotal reports, which by their nature cannot be used for claiming a causal relationship.

It is argued ***that pre-adolescent children are expected to be (potentially) more at risk than adults due to their higher head resonance absorption, their thinner skull, their higher mitotic activity the lesser robustness of their immune system to cope with adverse effects and their higher vulnerability to GSM 8,36 Hz and 2 Hz repetition frequencies*** (B6).

This hypothesis is not new. It has been addressed by accepted groups, e.g. by the UK Stewart report⁵ in stating that children may be more vulnerable to currently unrecognised adverse health effects. The arguments seem reasonable, however, their quantitative assessment is not taken into account by Dr. Hyland.

It is generally accepted by health advisory bodies that specific protection of children is justified. In fact, to account for sensitive sub-populations among the general population like children, was one of the reasons why the recommendations for exposure limits (e. g. by ICNIRP) contain reduction factors. Whether the existing reduction factors in the light of new findings are still sufficient is one among several other issues, which are currently being reviewed by the health advisory bodies. A dedicated short-term mission on specific dosimetric aspects in particular of emerging technologies in respect to children's heads has been started within COST action 281 recently.

2.5 Unbalanced voluntary selection of scientific papers

In his Tables I and II on “evidence” of health-relevant EMF bio-effects, Hyland fails to address the various papers reporting that effects could not be found or were in contradiction to other published results. This controversial situation is the reason why the whole body of data needs to be assessed and why a multidisciplinary group is needed to do so.

It would be beyond the scope of this comment paper to address every particular misleading point in Dr. Hyland's report. His unbalanced selection can be demonstrated by one of the most investigated effects.

On several occasions Dr. Hyland refers to the effect of EMF on the calcium signalling system of cells as an example for evidence of a frequency window effect and proof of

⁵ Stewart, W.: *Mobile Phones and Health. Report of the Independent Expert Group on Mobile Phones, Didcot 2000*

the biological importance of modulation frequencies. He is referring predominantly to research results, which until now have not been independently replicated, or the methodological errors of which e.g. due to outdated measurement techniques have already been identified (e.g. references /5/, /6/, /7/, /17/, /18/, /20/, /24/, /25/, /26/, /27/, /29/, /30/, /51/, /61/, /62/). Even after more than 26 years research there is no scientific consensus that it can be concluded that there is an established effect of EMF's on calcium flux across the cell membrane.

2.5 Use of non-scientific information

The existing exposure limits are challenged by the argument, ***“there is rather consistent empirical, anecdotal evidence from many countries that health of some people is adversely affected in various ways”*** by GSM radiation ***“well below the existing limits”*** (Hyland, B-4).

This argument suffers from two main deficiencies:

- it repeats a saying rather than quoting documented results, and it is not even anecdotal;
- it ignores the fact that there are already several studies on individuals and (self-aid) groups of people claiming to suffer from electromagnetic hypersensitivity, among them a European study. In spite of Hyland's claim the studies show it was not possible to support the hypothesis that weak EMF are causally related to non-specific health symptoms, nor was it possible to identify an EMF-specific symptom-cluster or personal risk profile. More than this, it was found that symptoms were correlated with the belief in, rather than the existence of, EMF exposure.

Dr: Hyland argues that ***“anecdotal reports are an indispensable source of information”*** in view of ***“the paucity of systematic epidemiologic studies pertaining to this relatively recently introduced technology”***.

However, anecdotal reports do not meet the minimal requirements for scientific data.

- If documented at all, anecdotal reports suffer from risk perception bias and individual conditioning.
- It is agreed within the scientific community as represented by their international bodies, that by their nature anecdotal results cannot be the basis for decisions on causal relations.

Therefore, it is misleading to claim that they were accepted as an indispensable source of information. However, they can be and are motivation for well designed scientific investigations, which have so far failed to show a causal relationship between health symptoms and environmental EMF exposure.

3 Conclusion

Unfortunately, the report delivered to STOA by Dr Hyland, in contrast to other reports such as that of the UK Stewart group, is unbalanced, uncritical and suffers from a narrow selection of partly outdated literature and arbitrary postulates. Dr. Hyland fails to base his conclusions on sound scientific data and provides a speculative submission rather than the result of thorough analysis of the whole body of existing scientific literature.

Furthermore, in contradiction to the basic frequency selective nature of possible weak field effects suggested by Dr. Hyland himself, results are cited as evidence for the health relevance of exposure to GSM, which were reported on EMF exposure at quite different frequencies, time courses and amplitudes.

To challenge the scientific requirement of replication and independent confirmation of effects for being considered as established, Dr. Hyland defends that already unconfirmed single findings should be seen as evidence by the scientifically unacceptable argument of the non-linearity and chaotic nature of biological processes.

Dr. Hyland challenges the existing exposure limits with the main argument, that due to the non-linearity of living systems significant health effects irrespective of the absorbed energy could be caused by their information and resonances with biological oscillations. This postulate, which he fails to base on experimental evidence, is a consequence of a significant misunderstanding of biological processes and a misinterpretation of anecdotal electromagnetic hypersensitivity reports.

As a consequence of a questionable assessment, which reflects by persons views rather than sound scientific analysis, Dr. Hyland on the one hand challenges the existing exposure limits and pleads for their drastic reduction and on the other hand favours the use of dubious protection methods.

Overall, Hyland's submission is not based on generally accepted scientific rules. It is of dubious scientific nature and does not reflect the view of the majority of the accepted scientific experts in this field. However, what it does do is demonstrate the importance of communicating the risk assessment based on up-to-date knowledge. Therefore, COST action 281 has decided to provide proper and balanced information for the public as given by this paper.

It is a fundamental mistake to believe that fear and unjustified concern, can be reduced by setting arbitrary EMF exposure limits. Such limits are no adequate means to reduce fear. They cannot substitute for adequate risk assessment and communication and confidence building in existing scientifically based limits.

It is the multidisciplinary task of scientists to assess the existing data and to draw conclusions based on the knowledge of established, presumed or unconfirmed health relevant effects. COST action 281 acknowledges that it is a political decision on which effects and on which level of knowledge exposure limits are to be based.

However, the scientific community of COST action 281 recognises that aside from scientific conclusions for setting legal EMF limits there are also other aspects to be considered e.g. social, economic or political, which can lead to different approaches in different countries.

Whatever the decision of national authorities and the European Parliament may be, it should be based on sound scientific assessment and not be arbitrary, nor based on advice of doubtful quality, nor on public emotions.

COST Action 281

Background

During the last century technological advances have rapidly changed the working and living conditions of most Europeans and were accompanied by increasingly widespread exposure of the general public as well as various occupational groups to electromagnetic fields (EMF's) of various frequencies, amplitudes and time courses.

Already in 1992 the European Commission established the 4-year COST action 244 "Biomedical Effects of Electromagnetic Fields" to co-ordinate and promote national research activities at a European level and to stimulate multidisciplinary collaboration between experts in the different fields of EMF research.

Because of the positive outcome and the need for further research this initiative was followed by a second 4-year action COST 244bis ending up with the establishment of a well-operating European scientific network of contacts and co-operation in this field and valuable outcome in terms of scientific reports and advice such as given for the 5th Framework Program.

It was a tribute to the rapid growth of mobile communication and information systems and the dynamic development of new emerging technologies that it was decided to start a new COST Action 281 "Possible Health Implications from Mobile Communication Systems" on September 2001 making use of the many scientific contacts established during the previous two COST actions. This was the reason why COST 281 could become active since the beginning.

For the time being, 18 signatory countries decided to actively participate in this action:

**Austria, Belgium, Bulgaria, Croatia, Denmark, Finland,
France, Germany, Greece, Hungary, Ireland, Italy,
Lithuania, Norway, Poland, Spain, Sweden, United Kingdom**

several others have already expressed their intention to join in the near future.

Besides this, contacts have been made with international bodies such as WHO, ICNIRP and EBPA and authorities and research organisations across the Atlantic ocean like Japan, Korea and the USA.

Objectives

The main objective of the Action is to obtain a better understanding of possible health impacts of emerging technologies, especially related to communication and information technologies that may result in exposure to electromagnetic fields.

Some secondary objectives are the providing of

- a scientific evaluation of the available data for use by various decision makers involved in risk management of electromagnetic
- a basis for risk communication efforts related to emerging technologies, electromagnetic fields and possible health risks and
- data on electromagnetic field exposures related to emerging technologies on a European level.

The dissemination of the results of the Action will be obtained by

- workshops and seminars
- newsletters and proceedings from these workshops
- a homepage: www.cost281.org
- summary reports and publications to policy makers.

COST 281: POTENTIAL HEALTH IMPLICATIONS FROM MOBILE COMMUNICATION SYSTEMS
Scientific Comment on Individual Statements of Concern about EMF Health Hazards

As it is demonstrated by this comment paper, COST action 281 has already accepted its role in risk communication. It is open for collaboration world-wide and will continue to keep and get into contact with interested parties.