



Mr Mike Hedges AM
Petitions Committee Chair
National Assembly for Wales
Cardiff Bay
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15 August 2016

Dear Mr Hedges

Petition P-04-553 A full and independent investigation in to the health risks of wireless and mobile phone technologies in Wales including all schools

Thank you for your letter of 3 August 2016 in which you refer to previous correspondence between PHE and Welsh Government officials, and advice that PHE has provided in relation to the above petition. You ask what action or consideration PHE has given to a package of information that was sent to us from Mark Drakeford AM in March 2016.

Before answering the question at issue, I should clarify that there is a great deal of information available on the subject of electromagnetic fields (EMFs) and health and that this information has arisen from research spanning several decades. Some idea of how much information is available can be gained from viewing the reference lists in published expert group reports, or perhaps more quickly by viewing the following website: <https://www.emf-portal.org/en>, where over 23000 publications were listed at the time of writing. Against this background, the small selection of studies that have been sent to PHE in connection with this petition is unlikely to represent the evidence as a whole.

Also, not all studies are equal. Some are higher quality than others and some are more relevant to human health than others. Expert committees have developed ways of gathering studies relevant to particular health topics comprehensively and impartially from the literature, then using agreed quality criteria to evaluate those studies critically and in a consistent manner, and using the scientific weight of evidence method to draw the evaluations together and reach overall health-related conclusions.

It would not be practical to repeat the detailed conclusions of recent rigorous expert reviews of the evidence in this letter but a summary of PHE advice (Annex B) has been included with this letter highlighting such reviews and their consistency with the 2012 review conducted by PHE's own independent Advisory Group on Non-ionising Radiation (AGNIR). AGNIR's

overall conclusion was that that, *"although a substantial amount of research has been conducted in this area, there is no convincing evidence that radiofrequency electromagnetic field exposures below guideline levels cause health effects in either adults or children"*. The guideline levels mentioned are those from the International Commission on Non-ionizing Radiation Protection (ICNIRP), which already serve as the basis for ensuring public health protection in the UK (See Annex B).

The AGNIR report gave specific consideration to Wi-Fi, including the results of a careful evaluation by PHE of exposure levels received by children when using the equipment in schools. The evaluation found exposures that were small in relation to exposure guidelines and in relation to those from mobile phones held to the head to make voice calls – a situation for which specific precautionary advice has been given (See Annex B). PHE advice about the use of Wi-Fi equipment in schools can be found at the following webpage and includes that PHE sees no reason why Wi-Fi should not continue to be used in schools and in other places.

<https://www.gov.uk/government/publications/wireless-networks-wi-fi-radio-waves-and-health/wi-fi-radio-waves-and-health>

Now, turning to the package of material received by PHE, which comprised 17 articles. Fifteen of these described original scientific studies, which is a very small subset of the literature that it is available. The remaining two articles are commentaries that do not appear to be systematic reviews and represent the opinions of their authors. No explanation was provided to PHE of how the 17 articles were selected or why it was thought that further consideration of them would inform our advice. The main possibilities investigated in the articles, i.e. that exposure to EMFs increases cellular damage via oxidative stress, impacts on the electrical activity of the brain, or causes loss of fertility are principal topics that have been examined in depth in published expert group reviews. In addition, the possibility that children might be more sensitive to exposure than adults, which is considered by one of the review articles, was first suggested in 2000 by the Independent Expert Group on Mobile Phones (the Stewart Report) and still forms the basis for the precautionary advice issued to parents by Government regarding limiting the use of mobile phones by their children (See Annex B).

In terms of process, the material received has been examined by our scientific experts to see if it contains evidence that might help to modify the advice that PHE has developed based on the formal reviews mentioned above. However, we chose not to comment on the material when it was sent to us. In going further now, I should stress that PHE has generally chosen not to comment specifically on individual studies that are sent to us: as an independent organisation, we think it is best if PHE uses its own judgement to decide when particular studies are important enough to comment on them outside the framework of comprehensive reviews. In this instance, and recognising the particular difficulty that this material presents to the committee, we have exceptionally taken the decision to comment on the 15 original articles sent to us in Annex A to this letter. It may be of interest to note that the exposure levels used in these studies are not always clear, but they seem substantially higher than those that typically occur when using Wi-Fi equipment.

Overall, the inclusion of the above studies does not modify our published advice on health effects of radiofrequency fields. In particular, the possible effects on oxidative stress are intriguing, but they are not yet sufficiently robust nor are any implications for public health at all obvious. This is especially true given the lack of epidemiological evidence indicating adverse effects on many health endpoints.

I hope this letter will prove helpful to the committee.

Yours sincerely

A handwritten signature in blue ink that reads "S. Mann". The letters are cursive and fluid.

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Enclosures

Summary of original studies sent to PHE in connection with this Petition (Annex A)

Summary of PHE advice on radiofrequency fields (Annex B)

Annex A

Summary of Original Studies Presented to PHE in Connection with Welsh Assembly Petition P-04-553

Eight studies reported exposure to pulsed 2.45 GHz signals increased various measures of oxidative stress in animal tissues or a human cell line. Six of these studies using animals, which came from the same laboratory and used the same protocol, also reported protective effects with daily administration of melatonin (Oksay et al, 2012; Nazıroğlu et al, 2012b; Aynali et al, 2013; or other antioxidants (Gumral et al, 2009; Nazıroğlu et al, 2009 Türker et al, 2011). A companion study using human cancer cells has deficiencies with exposure and dosimetry (Nazıroğlu et, 2012a) which renders the results largely uninterpretable. Finally, a study (Shahin et al, 2013) reporting that exposures of pregnant mice to a very low intensity field resulted in a complete resorption of fetuses, is contrary to many years of research showing such effects only occur following exposures that cause a significant elevation of maternal temperature.

Undoubtedly, the induction (and avoidance) of oxidative stress is very important in biology. Many well-conducted *in vitro* studies from different laboratories have not found any evidence that exposure increases oxidative stress in a variety of cell types. After reviewing the relevant literature in 2015, the EU Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) concluded “*several studies suggest that RF [radiofrequency] exposure in rodents can cause oxidative stress effects. The studies are however often lacking in proper dosimetry and do not include proper positive controls. The magnitude of the changes are modest, and their biological significance unclear*”.

Two studies reported effects on electrical activity of the brain in female volunteers (but not males) during exposure to Wi-Fi signals (Maganioti et al, 2010; Papageorgiou et al, 2011). Both studies come from the same laboratory and are part of a small series reporting exposure-related effects, possibly using the same set of volunteers. However, the study using an auditory short-term memory task does not appear to have been published in any recognised peer-reviewed journal. The second study reported effects only on one component of the EEG that is associated with decision making (the P300 wave) during the performance of a sentence completion task. Further, the only statistical difference seen was for the exposure X gender interaction in one of the three tested conditions of the test: the P300 amplitude of males was (non-significantly) higher than that of females without exposure and the amplitude of the females increased and that of the males increased during exposure, and this difference was statistically significant at 15 out of 30 electrode sites. P300 is often measured in psychological tests but the underlying neural circuitry responsible for the generation of the signal is uncertain, and AGNIR (2012) pointed out the relevance of this

type of study to human health was unclear. Similar studies have been conducted using mobile phone signals in a number of laboratories, but no consistent effects have been reported on the amplitude or latency for any component of the EEG.

Three of the studies investigated the effects of exposure to radiofrequency fields on sex cells (Atasoy et al, 2013; Avendano et al, 2013; Margaritis et al, 2013). One of these studies investigated effects of various types of field, including mobile and cordless phone signals, on egg-formation in fruit flies (*Drosophila*). Effects were reported with all signals, but the study used commonly available devices as a source of exposure without any measure of absorbed dose in the flies (which would have been far lower than the equivalent for a person in the same field, due to the very small size of the fruit flies). Similarly, the study reporting effects on rat testes from Wi-Fi signals used commercially-available devices, and the study using ejaculated human sperm placed the samples beneath a laptop that was connected to the internet via Wi-Fi. In neither study was there any control of exposure or an estimate of absorbed dose in the tissues. Overall, these deficiencies mean that the results cannot be used in any health risk assessment. The reviews of the literature by AGNIR (2012) and SCENIHR (2015) have both identified problems with studies not using appropriate field-generating systems with adequate control of exposure.

Lastly, two studies (Havas et al, 2010; Havas and Marrongelle, 2013) from the same laboratory suggest that exposure to a cordless phone signal may be associated with an effect on autonomic nervous system function (control of heart rate) and an increased frequency of non-specific symptoms, particularly in persons reporting hypersensitivity to EMFs. But results in one (non-peer-reviewed) study were variable, and it is not clear how the exposures were performed. The second study was retracted in 2014 due to a lack of ethical approval for the work by the host institution. Both these results are in stark contrast to those from other laboratories which did not find any effects in either sensitive people or members of the general population. SCENIHR concluded that symptoms are not associated with EMF exposure. That review also found no evidence that autonomic function was affected by exposure: the two studies highlighted were considered by SCENIHR, but were discounted because of doubts about the exposure system used.

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Annex B

Summary of PHE advice about the health effects of exposure to radiofrequency fields Role of Public Health England

Public Health England (PHE) came into being in April 2013, and advises the Government on all aspects of public health, including exposure to radio waves, the appropriate standards of protection for the general population and any measures necessary to protect sensitive groups. PHE inherited this responsibility from the former Health Protection Agency (HPA) and it continues to develop and provide a range of published information about radiofrequency topics. The material includes comprehensive scientific review reports and position statements, which can be found at:

<https://www.gov.uk/government/collections/electromagnetic-fields>

Within this suite of information are statements on the following frequently mentioned topics. The statements highlight assessments that have been done and which support the PHE view that exposures are small in relation to guidelines and not expected to pose a hazard to the public,

- Wireless networks (Wi-Fi), as used in schools and elsewhere
- Mobile phone base stations, including the latest 4G systems
- Smart meters for monitoring of domestic energy usage.

The situation with mobile phones, including their use by children, is somewhat different, as explained below, but also covered by published information.

Public exposure guidelines for radiofrequency fields: scientific evidence and consistency of PHE guidance with the international consensus

Central to PHE advice is that exposures to radio waves should comply with the guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is formally recognised by the World Health Organization (WHO). PHE has also issued precautionary advice to discourage the non-essential use of mobile phones by children. This precautionary advice recognises that exposures are much higher than occur in other situations, though still within the guidelines, when mobile phones are held to the head to make voice calls. Similar advice is not considered necessary with the lower exposures that occur from Wi-Fi equipment, smart meters and mobile phone base stations, including the latest 4G systems.

While exposure to radio waves is not new and health-related research has been conducted on this topic for many years, a large amount of new scientific evidence has emerged over the past few years. This knowledge has arisen through dedicated national and international research programmes that have addressed concerns about rapidly proliferating wireless technologies. The UK has contributed to the international research effort through various projects that have been commissioned, including through the Mobile Telecommunications and Health Research Programme (MTHR). As the research programmes have been coming to fruition, scientific expert committees have been reviewing the resulting evidence and coming to considered judgments at international, European and national levels, as explained below.

Alongside other European Union (EU) member states, the United Kingdom supports European Council Recommendation 1999/519/EC on limiting exposure to electromagnetic fields (EMFs), which include radio waves. This recommendation incorporates the 1998 guidelines from ICNIRP, as advised by Public Health England. ICNIRP restated the radiofrequency (RF) parts of these guidelines in 2009 on the basis of its own comprehensive review of the scientific evidence published at that time. ICNIRP concluded that *the scientific literature published since the 1998 guidelines had provided no evidence of any adverse health effects below the basic restrictions and did not necessitate an immediate revision of its guidance on limiting exposure to RF fields*. The 2009 ICNIRP review and statement on exposure guidelines can be found at:

<http://www.icnirp.org/PubEMF.htm>

The World Health Organization states that the main conclusion from its own reviews is that *EMF exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health*. WHO is presently preparing an Environmental Health Criteria (EHC) monograph covering the evidence in relation to radiofrequency exposures and health. This follows earlier EHCs published in 2006 on static fields and in 2007 on low frequency fields. Information from WHO about EMF exposure guidelines can be found at:

<http://www.who.int/peh-emf/standards/en/>

The European Commission is advised on the health aspects of EMF exposures by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). SCENIHR takes account of worldwide studies on EMFs and has produced several reports, known as Opinions, in which it expresses views broadly in line with those of PHE, ICNIRP and WHO. The most recent SCENIHR Opinion was published in March 2015 and contains detailed

conclusions on different aspects of the scientific evidence. A plain language summary based on the Opinion explains that *the results of current scientific research show that there are no evident adverse health effects if exposure remains below the levels set by current standards*. SCENIHR publications can be found through the following webpage and EMF Opinions are under the "Physical Risks" category:

http://ec.europa.eu/health/scientific_committees/emerging/index_en.htm

PHE publishes comprehensive reviews of the scientific evidence relevant to radio wave exposures and health from time to time. The most recent PHE-backed review was undertaken by its own independent expert Advisory Group on Non-ionising Radiation (AGNIR) and published at the end of April 2012. AGNIR undertakes comprehensive scientific evidence reviews of the biological effects of non-ionising radiation and suggests research priorities to improve public protection. The AGNIR report considered whether there was evidence for health effects occurring in relation to exposures below the ICNIRP levels. The overall conclusion was that, *although a substantial amount of research has been conducted in this area, there is no convincing evidence that radio wave exposures below guideline levels cause health effects in either adults or children*. The AGNIR report can be found at:

<https://www.gov.uk/government/publications/radiofrequency-electromagnetic-fields-health-effects>

Exposure to radiofrequency fields and cancer

A Working Group of the International Agency for Research on Cancer (IARC) reviewed the health effects of exposure to RF fields in May 2011 and concluded that such exposures are “possibly carcinogenic” to humans (Group 2B), based on IARC’s classification scheme. As explained in the monograph itself (published in 2013) there was a minority opinion in the Working Group that that current evidence in humans was inadequate, therefore permitting no conclusion about a causal association. The monograph on RF fields can be found at:

<http://monographs.iarc.fr/ENG/Monographs/vol102/index.php>

In putting the IARC “possibly carcinogenic” classification into context, it is worthy of note that, as of February 2015, 285 substances/situations are graded 2B by IARC, 70 as the higher “probably carcinogenic to humans” classification (group 2A) and 116 as the highest “carcinogenic to humans” classification (group 1). Among all of these classifications are many widespread and familiar substances/situations, including coffee and pickled vegetables (2B), shift working that involves circadian disruption (2A) and alcohol (1). The full lists can be found at:

<http://monographs.iarc.fr/ENG/Classification/index.php>

The IARC classification for radio waves was largely based on personal exposures associated with mobile phone use and the evidence was evaluated as being *limited* among users of wireless telephones for glioma and acoustic neuroma (cancers of brain/nerve tissues in the head), and *inadequate* to draw conclusions for other types of cancers. The evidence from environmental radiofrequency exposures, which include wireless telecommunications, was considered *inadequate* to draw conclusions.

Each carcinogenicity classification has to be looked at on its own merits, along with evidence relating to other health effects, in deciding on what is a proportionate public health response. IARC explains in the preamble to its monographs that their purpose is that of carcinogenic hazard identification, which is (only) the first step in performing a health risk assessment. For some exposures, it may be appropriate to do nothing, while for others it may be appropriate to seek to eliminate the exposure entirely. For radio wave exposures, the UK/PHE approach is between these two extremes and features the targeting of precautionary advice on the situation giving the highest exposure to the largest number of people, i.e. use of mobile phones held to the head in order to make voice calls. There is also a particular emphasis in that advice on those considered potentially most vulnerable, i.e. children, whose use of mobile phones should be discouraged.

HPA (now PHE) issued a response to the IARC classification when it was published and the classification has been taken into account in PHE advice. The response can be found at:

<http://webarchive.nationalarchives.gov.uk/20140714084352/http://www.hpa.org.uk/NewsCentre/NationalPressReleases/2011PressReleases/110531electromagneticfields/>

The topic of cancer effects also occupies a substantial part of the 2012 AGNIR report. The Group reviewed essentially the same evidence as the IARC working group and concluded that, although some positive findings have been reported in a few studies, overall the evidence does not suggest that using mobile phones causes brain tumours or any other type of cancer. The data, however, are essentially restricted to periods of less than 15 years from first exposure because mobile phones have only been in widespread use for that long. AGNIR considered it will be important to continue monitoring the evidence over the coming years, including that from national brain tumour trends, which have so far given no indication of any risk.

Continuing PHE precautionary advice about exposure to radiofrequency technologies

PHE (as the former HPA) responded to the 2012 AGNIR report maintaining its advice to follow the ICNIRP guidelines and also maintaining its long-standing precautionary advice in respect of exposures from mobile phones, which can give rise to exposures that approach the international guidelines when they are held to the head to make voice calls. The decision to maintain the precautionary approach reflected the continuing possibility of: (a) biological effects, although not apparently harmful, occurring at exposure levels within the ICNIRP guidelines, and (b) the limited information regarding cancer effects in the long term. Measures that mobile phone users may take to reduce their exposures were described in the HPA response to the AGNIR report.

In responding to the AGNIR report for situations giving rise to exposures that are already low in relation to guidelines (for example, those from Wi-Fi, smart meters or mobile phone base stations), PHE advised that community and individual measures to reduce exposures are not necessary. PHE is also committed to carefully continue monitoring the emerging scientific evidence, providing any necessary advice and undertaking another comprehensive review of the science once sufficient evidence has accumulated. The PHE response to the AGNIR report can be found at:

<https://www.gov.uk/government/publications/radiofrequency-electromagnetic-fields-health-effects>

Electrical sensitivity/hypersensitivity

The AGNIR report has carefully assessed whether certain people are especially sensitive to exposures to RF fields, leading to unpleasant symptoms which affect their health. Many studies have now been carried out, reflecting the importance ascribed to understanding the condition and making appropriate help available to sufferers. AGNIR concludes *there is increasing evidence that RF fields below guideline levels do not cause symptoms and cannot be detected by people, even those who consider themselves sensitive to RF fields*. PHE agrees with AGNIR that this does not undermine the importance of the symptoms that are experienced, but it does suggest causes other than those directly related to RF fields should be considered.

Unfortunately, the symptoms many people complain of are all too common in society, not just in those who consider themselves to be ill. Such findings are not new, for example in 1990, before the advent of modern communications technology, 27% of people complained of having had a headache in the last month (Blaxter). HPA published a review of the public health aspects of electrical sensitivity (EHS) in 2005 and this included comments on the

management of affected individuals and evaluation of treatment options. The report is available at:

<http://webarchive.nationalarchives.gov.uk/20140722091854/http://www.hpa.org.uk/Publications/Radiation/HPARPDSeriesReports/HpaRpd010/>

In terms of a practical way forward, WHO advises in its “backgrounder” document on EHS that *treatment of affected individuals should focus on the health symptoms and the clinical picture, and not on the person's perceived need for reducing or eliminating EMF in the workplace or home. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem.* For more information on WHO’s advice please follow the link below:

<http://www.who.int/peh-emf/publications/facts/fs296/en/index.html>

Acknowledging the range of opinion about the health effects of exposure to radiofrequency fields

Public Health England keeps emerging scientific studies worldwide under review and supports the scientific processes and officially mandated organisations described above. It is also aware of other reports and groups that have made pronouncements on this topic but gives greater weight to documents that use rigorous review processes and base their advice on the entire range of scientific information available.

Among the alternative sources of information on this topic are the 2007 and 2012 Bioinitiative Reports. PHE is aware of the contents of these reports, and of many other reports, and has considered their contents, but it has not responded to them. In part this is because other organisations have already reviewed these reports and drawn attention to problems that have affected their conclusions.

The Council of Europe Resolution 1815 (2011) also makes various recommendations and comes from the Council of Europe’s Committee on the Environment, Agriculture and Local and Regional Affairs. It is not clear exactly what evidence was considered or which experts were approached to submit evidence to their review. The Council of Europe is separate from the European Parliament and the European Commission.

Government and Public Health England are aware that there are people and organisations who believe more precaution is warranted for public exposure to radio waves in light of their view of the scientific evidence. However, the published reviews by AGNIR and internationally

recognised bodies do not, in the opinion of PHE, warrant more precaution than is already advised with respect to public exposure to radiofrequency fields.

PHE priorities for health improvement

In 2014, PHE published its report “From evidence into action: opportunities to protect and improve the nation’s health”. The document can be found at:

<https://www.gov.uk/government/publications/from-evidence-into-action-opportunities-to-protect-and-improve-the-nations-health>

PHE sets out in the report its seven priorities for the next 5 years, tackling obesity, reducing smoking, reducing harmful drinking, ensuring every child has the best start in life, reducing dementia risk, tackling antimicrobial resistance and reducing tuberculosis. Protection from environmental hazards, including uncertain ones like exposure to radio waves, is an important consideration for PHE, but it is also important to take a broad view across the whole range of health topics in deciding what actions are appropriate and proportionate. Unlike the hazards more specifically mentioned in the “From evidence into action...” document, and despite much research, there remains no clear evidence of harm to health from exposure to radio waves below the internationally agreed (ICNIRP) guideline levels that are already adopted in the UK.

Promotion of UK precautionary advice about exposure to radiofrequency fields

Precautionary advice for the public on radio wave exposures has been published in a leaflet from the Department of Health, on the NHS choices website, and in more technical sources such as the previously mentioned PHE response to the AGNIR report. Leaflets have also been prepared in Wales with the involvement of school children. PHE’s view is that provision of this material on the internet reflects the appropriate priority of this particular topic within the broader context of all messages directed to the public about their health.