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Communication of risk: health hazards from mobile phones

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Summary. Possible health hazards from mobile phones arise from the use of the phones themselves and via the base stations that relay signals. Except for an increase in traffic accidents induced by the use of mobile phones in cars the evidence for a health hazard is at most indirect, but it cannot be entirely dismissed; the phones have not been widely used for sufficiently long for direct epidemiological studies to have high sensitivity for detecting any induced incidence of cancer, for example. The background and evidence are briefly reviewed and the steps taken in the UK to make information widely available described.

Keywords: Athermal effects; Electromagnetic field; Epidemiology; National Radiological Protection Board; Precautionary principle; Thermal effects; Traffic accidents

1. Introduction

Mobile phones provide an interesting example of a source of risk to health which may be largely non-existent but which cannot be totally dismissed. Such risks, when possibly serious and with long-term consequences, are typically dealt with by appeal to the so-called precautionary principle but, of course, precaution comes at a price.

In the UK, mobile phones operating on an analogue principle were introduced for the general public in the mid-1980s but the increasingly widespread use of mobile phones dates from about 10 years later with the availability of low power phones working on a digital system. By the end of 2001 there were about 25 million subscribers in the UK, although frequent users are no doubt fewer. There was similar growth in other areas of the world with, however, two-thirds of all users being in Europe.

There has been wide international interest in the possible effect of mobile phones on health and several substantial reports have reviewed the evidence. The rest of the present paper is based on a report written for the UK Department of Health by the Independent Expert Group on Mobile Phones which reported in May 2000 (Stewart, 2000); subsequent references are to paragraphs of that report. The Group was independent of but received administrative support from the National Radiological Protection Board, the Government-supported body that is responsible for information and advice on radiation hazards.

The report recognizes the advantages that have stemmed from mobile phones; their widespread popularity could be said to speak for itself.

Recently Boice and McLaughlin (2002) have given a valuable review, which is available at www.ssi.se, of the most recent epidemiological evidence, summarizing the main studies and commenting on their respective strengths and weaknesses.

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2. The background

A mobile phone transmits a radio frequency signal mostly at around 900 MHz or 1800 MHz to a base station where it is passed into the main telephone network either by cable or by a high frequency radio link. The distance to the base station must be less than 35 km, even without obstruction by hills etc., so an extensive network of base stations is needed, there being about 20000 such stations in the UK, each serving a macrocell, with smaller stations serving microcells, or inside large buildings picocells used to infill the network in areas of high use.

Brevity precludes describing in more than outline how the system works. Each base station has a few hundred channels; a technique called time division multiple access allows each of eight channels to be used by up to eight phones. A further technique called adaptive power control adjusts continually the power of the signal to the minimum that is necessary for clarity; for a phone near the base station the reduction can be by up to a factor of 1000. Finally discontinuous transmission switches off the signal whenever a user stops speaking.

Licences were issued in 2000 for the so-called third-generation mobile phones. These will provide enhanced facilities in somewhat higher frequency bands and might thus raise new health considerations.

3. Possible adverse effect from base stations

There are possible adverse effects stemming either from the base stations or from the phones themselves. There has been appreciable public concern over the former, especially over the siting of base stations on or very near school buildings.

The signal from a base station has a narrow main beam reaching the ground 50–200 m from the tower, typically 10–30 m tall. The electric field strength is likely to be 50–100 times smaller than that 2 cm from a phone. Someone approaching the antenna at the top of the tower or on a roof could, however, experience a much stronger signal.

There are other aspects of the siting which may cause concern and loss of well-being, e.g. aesthetic issues connected with the placing of unpleasant looking tall towers in residential areas.

Several epidemiological studies have examined the incidence of cancer in those living near radio or television transmitters. The report concluded (paragraph 5.247), after a review of this work, that the balance of evidence does not indicate a hazard, but that the limitations of the studies are such that they do not strongly exclude an effect.

Although it seems that any health hazard is more likely to come from the phones themselves than from base stations, the report made recommendations (paragraphs 1.36 and 1.38–1.47) concerning the planning process, consultation, siting near schools, the need for random checks on the fields actually emitted and the need for more research.

4. Possible short-term adverse effects from mobile phone use

There is a possibility that mobile phones could interfere with sensitive equipment, e.g. in hospitals.

There is appreciable evidence that the use of mobile phones, whether hand held or not, while driving is hazardous. The evidence is of two kinds. There are many experimental studies, often using laboratory tasks to simulate driving, that concur in showing a degradation of performance. The limited epidemiological evidence confirms this. In particular a case–control study (Redelmeier and Tibshirani, 1997) of relatively minor traffic accidents in urban Toronto...
suggested a 4–6-fold increase of risk. The conclusion in both types of study that the adverse effect is both for non-hand-held phones and for hand-held ones suggests that the key issue is the distraction of attention.

Surveys in Sweden, Norway and the UK have shown that something between 10% and 30% of users report some adverse effects, such as headache, which they associate with mobile phone use. Further, some individuals report extremely severe headaches and related symptoms soon after using a mobile phone. Ideally double-blind studies are desirable to isolate the processes involved and to confirm or otherwise that mobile phones are indeed the source of the symptoms, but there seem to be no reports in the literature of such investigations.

5. Possible long-term adverse effects of mobile phone use

Radio frequency radiation is non-ionizing, i.e. the quantum of energy is much too small to break a chemical bond in the way that ionizing radiation such as X-rays or \( \gamma \)-rays can. As such the radio frequency radiation is to be expected to be harmless at low intensities and the key issue is the level at which harm is likely. The initial consideration of this centred on thermal effects. These are assessed via the specific energy absorption rate SAR. This, measured in watts per kilogram, gives the rate at which energy is absorbed by a particular mass of tissue. It varies across the body and it could be rather larger in children than in adults. Guidelines from the National Radiological Protection Board and internationally by the International Commission on Nonionizing Radiation Protection specify limits within which exposure should fall. These are designed to ensure that heating, in particular within the head, is kept to a low level. Heating can be measured directly only on the surface of the skin so internal heating must be inferred by theoretical calculation. It seems likely that increases of the order of 0.1 °C are involved. Current phones appear to meet the guidelines. There is now an international standard for attaching an assessment of SAR to phones. Since October 2001 new phones give the SAR value in the technical specification in the box and information is available also on manufacturers’ Web sites. This will provide a base for choice on buying a phone and hopefully will encourage manufacturers to develop phones generating lower fields.

More recently, however, research interest has largely moved to possible biological, i.e. athermal, effects arising from an impact of the pulsed field on basic processes, e.g. at the cellular level. The evidence is comprehensively reviewed in the report (paragraphs 5.12–5.175) and is complex and confusing, in part because of a lack of clarity in descriptions of details of experimental design. The essence is, however, that there is evidence of biological effects but not that they are harmful to health.

One study reporting positive results is that of Repacholi et al. (1997) who irradiated transgenic mice for 1 h per day for 18 months with 900 MHz radio frequency radiation and reported an excess of lymphoma compared with controls. Utteridge et al. (2002) used the same strain of mice at a range of much higher SARs and found no effect. The overall assessment of Boice and McLaughlin (2002) noted that the first study was a pilot and concluded that currently there is no convincing evidence of either a cancer initiation or promotion effect from a range of mobile phone frequencies.

There had been at the time of the report about 10 direct epidemiological studies of the effect of radio frequency fields on lymphatic and haematopoietic cancers and another 10 on brain tumours. The various studies considered by the Expert Group are so disparate in nature that it was felt that a formal summary analysis was not merited; in any case their relevance to mobile phones may be questioned. The general conclusion is that there is so far no convincing evidence of an adverse effect. Boice and McLaughlin (2002) cover some major studies that have reported
more recently; the conclusion is that there is no evidence of a carcinogenetic effect over up to a 5-year time span.

As is perhaps inevitable in view of the difficulty and expense of such epidemiological studies even the most careful are open to some criticism. Thus the large case–control study of Inskip et al. (2002), involving nearly 800 cases and a corresponding number of controls, used hospital-based rather than community-based controls, taking patients admitted to the same hospitals for non-malignant conditions. Although roughly 40% used a mobile phone, only about 12% had done so for 3 or more years. One of the few case–control studies to use community-based controls (Auvinen et al., 2002) involved cases identified from the Finnish Cancer Registry and controls from the Finnish Central Population Registry, with identification of mobile phone users from lists of personal subscribers provided by mobile phone companies. Such a procedure would be feasible in few countries. That only about 10% of controls recorded mobile phone use suggests substantial underreporting of real use (Boice and McLaughlin, 2002).

Because mobile phones of the present form have not been in use for very long, direct epidemiological evidence of adverse effects with an appreciable latency period cannot be available. Thus although, as noted above, the evidence about the short-term is encouraging, it may be a considerable time before the position about long-term effects becomes clear from direct epidemiological evidence. As sketched above, the underlying scientific evidence is reassuring over possible thermal effects. There is dispute about possible athermal effects, both about their existence and about their potential effect on health if they should exist.

In such situations it is popular to appeal to the precautionary principle, i.e. to take precautions against the hazard in question without waiting for clear evidence that the risk is real. In 2001 the UK Secretary of State for Health wrote to chief executives of mobile phone retail companies reminding them that they should ensure that customers receive the Department's precautionary advice, in particular to keep calls short. This is not the place for an extended essay on the precautionary principle, a principle which seems first to have been explicitly formulated by a West German Government in its concern over environmental issues. There is clearly a difference between aspects that involuntarily affect whole communities and those of specifically individual concern; in the latter case publicity with relevant information may be deemed enough. Although the broad ideas of decision theory or economic analysis may apply to the balance of issues involved, it is unlikely that such ideas can be usefully applied quantitatively to precautionary issues at a community or national level. Among the negative aspects of over-precaution are not only the loss or restriction of facilities that may be involved and the possible diversion of resources away from more serious concerns but also the engendering of unnecessary anxiety about small or non-existent risks. This is, of course, not to dispute the relevance of the precautionary principle to such issues as major environmental matters including effects of climate change. The precautionary principle is perhaps most relevant in the present context to the siting of mobile phone masts; see Section 6.

Finally there is some intriguing evidence that performance in certain cognitive tasks is improved when the subject is receiving a synthetic mobile phone signal (paragraphs 5.194 and 5.195). For a recent review, see Cook et al. (2002).

6. Public communication

The communication of risks to the public was of considerable concern to the Independent Expert Group and they made several recommendations (paragraphs 1.61, 1.62 and 1.65) to this end, in particular that an appropriate leaflet should be provided at the point of sale. The Group
had taken oral and written evidence from a wide range of individuals and organizations and held open public meetings in five cities across the UK.

The report contains further detailed recommendations to the Government. The report received appreciable newspaper, radio and television coverage at the time of issue.

About 2000 copies of the report itself were distributed and it is publicly available at www.iegmp.org.uk. The site had been visited about 850000 times up to December 2001. The National Radiological Protection Board has produced a half-hour video explaining in very precise but simple language the issues that are involved. For details see www.nrpb.org.

Have these efforts to convey the issues involved been successful? What more could and should be done?

For those, such as local government officers and others, involved in specific decision-making the report provides not only a considered summary of relevant knowledge about key issues, such as fields from base stations, but also a careful yet readable review of the wide-ranging scientific studies that are involved. The bibliography contains roughly 500 papers. The report will need to be updated as new information, and in particular the results of further experimental and epidemiological investigations, becomes available.

There are special considerations for those who are exposed occupationally to exceptional fields.

What are the considerations of the more general public? First it is not clear how wide is the concern over these issues, at least apart from the siting of base stations. At the time that the report was being prepared (October 1999–April 2000) there were frequent press reports of local meetings protesting at the siting of masts. My impression is that these reports are now less frequent although I understand that Ministerial offices still receive a steady stream of letters objecting to base stations. The anxiety about masts may arise from a combination of the continuous and involuntary nature of the exposure and of concern at the aesthetic consequences of the appearance of unsightly towers in residential areas. It is unclear which is the predominant aspect.

Otherwise, many of wide-ranging recommendations of the report have been adopted including the setting up of a major research fund supported equally by the Government and industry; see www.mthr.org.uk. Other than making up-to-date information easily accessible there may at present be nothing else that can or should be done.

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References


