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ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH CAUTIONARY POLICIES

Potential health effects of man made electromagnetic fields (EMF) have been a topic of scientific interest since the late 1800s, and have received particular attention in the last 40 years. Common sources of these fields include power lines, household electrical wiring, appliances and motor driven instruments, computer screens, telecommunications and broadcast facilities, mobile telephones and their base stations.

Public exposure to EMF is regulated by a variety of voluntary and legal limits. The most important of these are international guidelines drafted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) together with various national safety standards. Guidelines are designed to avoid all identified hazards, from short and long term exposure, with a large margin of safety incorporated into the limit values. Actual exposure levels are nearly always far below recommended limits.

Uncertainties about EMF

Assessment of potential health risks of EMF includes numerous uncertainties. In particular, a number of epidemiological studies suggest the existence of weak links between exposure to EMF and human disease. The studies involve a variety of diseases and exposure conditions. However, the largest body of evidence involves a possible increase in risk of leukaemia in children associated with exposure to electric and magnetic fields at power frequencies (50/60 Hz) in the home. Other scientific evidence, including a large number of animal studies, does not support this conclusion, and many of the epidemiology studies themselves suffer from problems including inadequate exposure assessment.

Expert committees that have reviewed this evidence have consistently found it to be too weak to be persuasive. For example, in 1997 the US National Research Council concluded, "the current body of evidence does not show that exposure to [power frequency electric or magnetic fields in the home] presents a human health hazard." Similarly, in its 1998 guidelines for EMF exposure, ICNIRP stated that the "results from the epidemiological research on EMF field exposure and cancer ... are not strong enough to form a scientific basis for setting exposure guidelines." No major committee has concluded that a hazard actually exists from low-level fields. But clearly there is considerable scientific uncertainty as well as a high level of public apprehension about the issue.

Precautionary Policies

Throughout the world there has been a growing movement inside and outside of government to adopt "precautionary approaches" for management of health risks in the face of scientific uncertainty. As an international health agency, WHO does not normally advise national authorities to set policies that go beyond established knowledge. Yet within the declaration signed in London at the 1999 Third Ministerial Conference on Environment and Health, WHO was encouraged to take into account "the need to rigorously apply the Precautionary Principle in assessing risks and to adopt a more preventive, pro-active approach to hazards".

Several different policies promoting caution have been developed to address concerns about public, occupational and environmental health issues in the face of scientific uncertainty. These include:

- Precautionary Principle
- Prudent Avoidance
- ALARA (As Low As Reasonably Achievable)

The Precautionary Principle is a risk management policy applied in circumstances with a high degree of scientific uncertainty, reflecting the need to take action for a potentially serious risk without awaiting the results of scientific research.

For countries of the European Union, the Treaty of Rome states that "Community policy on the environment ... shall be based on the precautionary principle." A recent instance of adoption of the Precautionary Principle is the European Commission's decision to ban beef from the United Kingdom, with a view to limiting the risk of transmission of bovine spongiform encephalopathy (BSE). The European Court of Justice ruled that this decision was justified:

In view of the seriousness of the risk and the urgency of the situation, and having regard to the objective of the decision, the Commission did not act in a manifestly inappropriate manner by adopting the decision, on a temporary basis and pending the production of more detailed scientific information

Where there is uncertainty as to the existence or extent of risks to human health, the Commission may take protective measures without having to wait until the reality or seriousness of those risks becomes apparent.

On 2 February 2000, the European Commission approved an important communication on the Precautionary Principle providing guidelines for the application of the Principle. According to this communication, measures based on the precautionary principle should be

- tailored to the chosen level of protection,
- non-discriminatory in their application, i.e. they should treat comparable situations in a similar way,
- consistent with similar measures already taken, i.e. they should be comparable in scope and nature to measures already taken in equivalent areas in which all scientific data are available,
- based on an examination of the potential benefits and costs of action or lack of action (including, where appropriate and feasible, an economic cost/benefit analysis),
- provisional in nature, i.e. subject to review in the light of new scientific data, and
- capable of assigning responsibility for producing the scientific evidence necessary for a more

comprehensive risk assessment.

In this definition, the Precautionary Principle is "risk-oriented", in that it requires an evaluation of risk research including cost-benefit considerations. It is clearly intended for use in drafting provisional responses to potentially serious health threats, until adequate data are available for more scientifically based responses.

Prudent Avoidance was initially developed as a risk management strategy for power frequency EMF by Drs. Morgan, Florig and Nair at Carnegie Mellon University. In their 1989 report to the US Office of Technology Assessment these authors defined Prudent Avoidance as "taking steps to keep people out of fields by rerouting facilities and redesigning electrical systems and appliances". Prudence was defined as "undertaking those avoidance activities that carry modest costs".

Since 1989 Prudent Avoidance has evolved to mean taking simple, easily achievable, low cost measures to reduce EMF exposure, even in the absence of a demonstrable risk. The terms "simple", "easily achievable", and "low cost", however, lack precise meaning. Generally, government agencies have applied the policy only to new facilities, where minor modifications in design can reduce levels of public exposure. It has not been applied to require modification of existing facilities, which is generally very expensive.

Defined in this way, Prudent Avoidance prescribes taking low-cost measures to reduce exposure, in the absence of any scientifically justifiable expectation that the measures would reduce risk. Such measures are generally framed in terms of voluntary recommendations rather than in terms of fixed limits or rules.

Prudent Avoidance (not necessarily identified as such) has been adopted as policy in parts of the electrical sector in Australia, Sweden and a few US states (California, Colorado, Hawaii, New York, Ohio, Texas, and Wisconsin). In 1997 Australia adopted a policy of Prudent Avoidance with regard to new transmission lines, with measures described by the government as "general guidance" to be implemented "without undue inconvenience." Measures that can be taken at "modest cost" include routing power lines away from schools, and phasing power line conductors to reduce magnetic fields near their rights of way.

In the United States, no national body has explicitly recommended a policy of Prudent Avoidance for powerline fields. However, in its recent recommendations to the US Congress, the National Institute for Environmental Health Sciences (NIEHS) came close, by suggested that "the power industry continue its practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating hazards. We also encourage technologies that lower exposures from neighbourhood distribution lines provided that they do not increase other risks, such as those from accidental electrocution and fire".

By contrast, in the cover letter to the NIEHS report to Congress, Kenneth Olden, Director of NIEHS, recommended instead "passive regulatory action" such as "educating both the public and the regulated community on means aimed at reducing exposure...". This recommendation is somewhat different from Prudent Avoidance in that it advocates educational measures, rather than taking actual measures to reduce exposure.

Prudent Avoidance has not been formally adopted in the US for regulation of communications or commercial broadcasting facilities. However, government agencies have made recommendations to the telecommunications industry that could be considered as forms of Prudent Avoidance. In 1999 the U.S. Food and Drug Administration (FDA) urged the mobile phone industry to design phones that minimize user exposure to RF fields to levels necessary for the device's function.

In Prudent Avoidance, as implemented by various countries, prudent refers to expenditures, not an attitude to risk. It does not imply setting exposure limits at an arbitrarily low level, and requiring that they be achieved regardless of cost, but rather adopting measures to reduce public exposure to EMF

at modest cost. There is no requirement for assessment of potential health benefits.

ALARA is an acronym for As Low As Reasonably Achievable. It is a policy used to minimize known risks, by keeping exposures as low as reasonably possible, taking into consideration costs, technology, benefits to public health and safety and other societal and economic concerns. ALARA today is mainly used in the context of ionizing radiation protection, where limits are not set on the basis of a threshold, but rather on the basis of "acceptable risk". Under these circumstances, it is reasonable to minimize risk that can be presumed to exist even at levels below recommended limits, on the grounds that what constitutes "acceptable risk" can vary widely among individuals.

ALARA has not been applied to setting public policy related to exposure to EMF. Indeed, it is not an appropriate policy for EMF (either powerline or radiofrequency fields) in the absence of any expectation of risk at low exposure levels and given the ubiquity of exposure.

Precautionary Policies for EMF

Prudent Avoidance and other cautionary policies regarding EMF exposure have gained popularity among many citizens, who feel that they offer extra protection against scientifically unproven risks. However, such approaches are very problematic in their application. The chief difficulty is the lack of clear evidence for hazard from chronic exposure to EMF below recommended guidelines, or any understanding of the nature of a hazard should one exist. While the weight of evidence needed to trigger a cautionary policy is undoubtedly lower than that needed to set exposure guidelines, clearly a hazard must be identified and some understanding is needed of the conditions under which it is likely to be present.

Another difficulty is the ubiquity of EMF exposure in modern society, at highly variable levels and over wide frequency ranges. It is therefore difficult to create cautionary policies that have consistency and equity. For example, typical urban environments contain a multitude of radiofrequency transmitters, ranging from low power communications transmitters to very high power broadcast transmitters. It is difficult to envision a consistent and equitable cautionary policy that would minimize radiofrequency EMF exposures from cellular telephone base stations given the presence of far higher powered sources in the same urban area. Indeed, attempts to implement a cautionary policy for cellular telephone masts have typically been done on a piecemeal basis, with no attention to other (much stronger) sources of RF energy in the environment.

Implications for Guideline Limits

The above considerations suggest that a cautionary policy for EMF should be adopted only with great care and deliberation. The requirements for such a policy as outlined by the European Commission do not appear to be met in the case of either power or radio frequency EMF; however other related policies, such as Prudent Avoidance, may be justified.

A principle requirement is that such policies be adopted only under the condition that scientific assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. That would occur, for example, if limit values were lowered to levels that bear no relationship to the established hazards or have inappropriate arbitrary adjustments to the limit values to account for the extent of scientific uncertainty.

It is possible to introduce cautionary policies without undermining science-based standards. In 1999, the New Zealand Government issued their RF exposure standards that follow the 1998 ICNIRP EMF guidelines. The Ministries of Health and Environment noted that it considered the basic restrictions and reference levels in its standard to "provide adequate protection". However, the Ministries noted that community concerns over RF exposure might be addressed by "...minimizing, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this can be readily achieved at modest expense". This emphasis on reducing exposure at "modest expense" with no evidence of prospective health benefits or cost-

benefit analysis, marks this policy as a form of prudent avoidance, not an application of the Precautionary Principle as outlined by the European Commission.

Other measures, not related to precautionary approaches, can help address public concerns, which typically arise when new electrical facilities are proposed. These might include public input or participation in decisions regarding siting of power lines, electrical substations or radiofrequency transmitters. In addition, individuals can choose to take whatever measures they feel are appropriate to their situation and circumstances. Such actions may include repositioning bedside electrical equipment, such as clock radios, or moving a child's bed to an area of the bedroom that has a lower magnetic field. Turning off electric blankets before going to bed may also be an option. People conducting extended mobile phone conversations could use an earphone-microphone headset (hands-free kit) and hold their mobile phone away from their bodies. Such actions should not be recommended by national authorities on health grounds but may be appropriate for individuals depending on their perception of the risks involved.

For further information, please contact WHO Office of Press and Public Relations, Geneva. Tel (4122) 791 2599, Fax (41 22) 791 4858. Email: inf@who.int. All WHO Press Releases, Fact Sheets and Features as well as other information on this subject can be obtained on Internet on the WHO home page <http://www.who.int/> WHO's International EMF Project maintains an updated set of fact sheets giving information about all major sources of EMF exposure. Fact sheets on key issues have been translated into many languages and are available from WHO or on the Project home page at www.who.int/emf