

EXECUTIVE SUMMARY

Introduction

While radio waves and other forms of electromagnetic energy have been in use for decades, the recent dramatic increase in the use of the microwave portion of the spectrum for wireless technology such as mobile phones, the proliferation of mobile phone towers and antennas and accompanying anecdotal and scientific evidence showing biological and possible health effects associated with this technology, have led to increased public concern about their safety.

The Committee found interpretation of the results of studies of electromagnetic radiation and its effects on living systems to be highly complex, contradictory and contentious.

The Committee's understanding of the implications of scientific research findings was made difficult by the variable and complex nature of genes, immune and other biological systems, debate about the importance of replication of studies, the vexed question of the influence of the telecommunications industry in the design, funding and interpretation of studies and the lack of consensus about implications for health and safety.

The Committee has found that while adverse health effects are not agreed upon, the existence of biological effects associated with radiofrequency radiation is now recognised.

For these reasons the Committee Chair recommends a rigorous precautionary approach in all areas of the deployment of wireless technology, that radiofrequency (RF) emissions be kept As Low As Reasonably Achievable (ALARA), and that the expired interim exposure Standard not be adapted to the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines.

The research

The science on which the current non-ionising radiation standards is based, relates to the capacity of heating to cause adverse health effects and, while these 'thermal effects' are said to be understood, interpretation of studies showing biological effects of non-thermal exposure to electromagnetic radiation remains contentious and knowledge about the mechanism which causes those effects is still limited.

Studies examining the relationship between radiofrequency radiation and biological and health effects have been extensively reviewed in Australia and overseas, but the conclusions made in these reviews have been uncertain and in many respects, contradictory with different conclusions drawn about whether or not the scientific evidence was sufficiently reliable as a basis for sound judgments on exposure levels.

While the CSIRO said too little relevant research had been carried out, the European Commission took the approach there was no convincing evidence to suggest a long term public health hazard. The World Health Organization (WHO) said there were no known health hazards associated with radiofrequency. The Royal Society of Canada and the Stewart Reports concluded that although biological effects had been demonstrated, there was no evidence of documented health effects but they did not rule out the possibility that they existed.

One of the most contentious issues with regard to the validity afforded scientific studies is the question of replication. Industry argued that studies cannot be regarded as reliable evidence unless replicated but the Committee heard evidence of difficulties in attracting funding for replication studies, lack of interest in such work, unforeseen variables, particularly with regard to the genetic make-up of animals, changes and sometimes improvements in the methodology and the argument that the weight of evidence is as important as the confirmation of individual studies.

Whilst industry, the WHO and government submissions argued that the science was inconclusive, others said that the majority of peer-reviewed, published scientific research showed effects from non-ionising radiation including DNA damage, heat shock protein response, changes in the movement of substances across cell membranes, changes in the blood brain barrier, oncogene change, melatonin reduction and altering of calcium ion signalling.

In animals, studies have shown chromosome aberrations, increases in double and single strand DNA breakages, increases in the promotion of certain cancers in genetically predisposed mice, severe depression of the immunological and endocrinological responses of young chickens, changes in temperature regulation, changes to calcium ion mobility in the brains of cats and rabbits, changes to the proliferation rate of cells, alterations to enzyme and nervous system activity and behavioural change, at low level exposure to radiofrequency radiation.

The body of scientific research, whilst substantial, was criticised by the Stewart Report as inconsistent, inadequate, based on single experiments rather than a consistent series of hypothesis-driven investigations. Dr Neil Cherry argued that the evidence of biological evidence was solid and consistent but that much of it had not been sighted, summarised or integrated. The Royal Society of Canada Report said that studies showing observed biological effects that it reviewed were well-designed, had appropriate positive and/or negative controls, contained valid RF exposure parameters, included appropriate statistical evaluation of the significance of the data and had been observed to occur by more than one investigator.

Possible mechanisms

Professor Litovitz said his work using electromagnetic fields to protect against damage due to heart attacks and to treat cancer and inflammation led him to the theory that, through a signal transduction, electromagnetic signals reach the surface of the cell or receptor and send a signal to the nucleus which proceeds to undergo various biochemical processes and, in particular, alters the levels of protective proteins.

Dr Peter French suggested that continual use of a mobile phone could potentially induce the chronic expression of heat shock proteins which can lead to increased metastasis, initiation and promotion of cancer and resistance to anti-cancer drugs. He said the mechanism by which microwaves may cause protein unfolding, leading to heat shock response, could be a resonance of the microwave field with the protein or water in the cell but that this was as yet only a hypothesis.

Dr Neil Cherry said it had been demonstrated that oscillating signals interfere with the brain and can change the EEG, and therefore calcium ions, by resonant absorption.

The Committee Chair is persuaded that without an understanding of biological mechanism(s) responsible for observed effects it is not possible to accurately establish safety limits.

Whilst some witnesses argued for the need to clearly distinguish between the evidence for adverse health effects from exposure to radiofrequency radiation such as that from mobile phones and extremely low frequencies (ELF) (primarily 50/60 Hz) such as those from powerlines, others said that the cell's characteristic response was the same. Many studies cited during the inquiry related to ELF and report observed effects from exposure to ELF on the reproductive system, blood changes, ECG, heart rate, blood pressure, body temperature, melatonin and cancer.

Cancer

The development and promotion of cancer ranks in the general public's mind as a real health risk associated with mobile phones, but again, the scientists and reviewers disagree about the evidence.

The Stewart Report said studies of brain cancer provided inconsistent results, and others commented that there were inherent selection biases, numbers too small to be reliable and that better designed studies tended to show no association.

The CSIRO pointed out that one animal study often cited as negative was analysed by separating out each type of cancer whereas the overall incidence of primary malignancies between the exposed and the control group showed a fourfold increase.

The Telstra-funded study in 1997 on mice genetically predisposed to lymphoma showed a doubling in the incidence of the cancer in the group exposed to mobile phone frequencies.

Studies done on human exposure to analog mobile phones have shown no short term effect but researchers have recommended that further research is undertaken to account for longer induction periods, particularly for slow-growing tumours and for the differences between analog and digital mobile phones.

Cases which examined cerebral tumours, found no association between cancer and the duration of mobile phone use but tumours did occur more frequently on the side of the

head to which the phone was customarily held. In one study temporal lobe cancers occurred more frequently on the opposite side of the head.

Other health effects

An Australian study of 40 people who identified health effects from mobile phone use showed symptoms including dull pain, an unpleasant warmth or heating, as well as ache, throb, sharp pain and pressure. Most respondents felt the sensation less than five minutes after commencing the call, but for others the sensation built up as the day progressed. For some the sensation lasted less than an hour after ceasing calls, for others it lasted for many hours. The author of the study, epidemiologist Dr Bruce Hocking, said this was the first clear indication of a health effect on humans attributable to a mobile phone.

There was disagreement about the implications of studies showing effects on the cardiovascular system, brain function and the immune and neurotransmitter systems but it was agreed that further research should be conducted in these areas.

Ten epidemiological studies have found significant miscarriage from EMR exposure across the spectrum from ELF and SW to RF/MW. The Scandinavian study of physiotherapists found significant prematurity, congenital malformation, still-birth and cot death but reviewers said that the numbers exposed to microwave equipment were too small to provide reliable risk estimates.

A Greek study of mice placed at various locations in relation to a RF transmission tower showed the low exposure group became infertile after five generations and the high exposure group after three generations. This study was said by reviewers to be inconclusive because it did not include matched control groups or take into account other environmental factors. The potentially greater sensitivity of children to the effects of electromagnetic radiation, was also the subject of disagreement amongst scientists and reviewers. Ionising radiation and some chemicals are known to have the greatest effect in causing brain and nervous system cancer in rats when administered early in life during which time the nervous system is developing but this has not yet been established for mobile phone exposure.

The implications for children of greater absorption of RF because of thinner skulls and brain tissue containing more ionic fluid and therefore higher conductivity were disputed. The Stewart Report recommended that children be discouraged from using mobile phones for non-essential calls and that the industry refrain from promoting the use of mobile phones by children, however the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) disputed the conclusion that led to the recommendation saying that whilst it was true that children are likely to be exposed for a much longer time than adults, in the absence of any knowledge of an injury mechanism, there is no reason to believe that children will be inherently more vulnerable than any other age group.

Given the increasing use of mobile phones by young children and teenagers, the Committee considers that research into the effects of mobile phone technologies on

young people should be treated as a priority and that material should be developed to advise parents and children of the potential risks associated with mobile phone use.

Mobile phone towers and base stations

There were differing claims about the risks of exposure to mobile phone base stations and transmitters. Submissions expressed concern about the continuous and involuntary nature of the exposure however it was generally accepted that radiation from mobile phone towers is potentially less harmful than mobile phone emissions and ARPANSA argued that mobile phone base stations contribute only a small amount of RF compared with radio and television transmission.

In spite of this and the controversy surrounding results of the Hocking study which found a 60 per cent increase in leukaemia in children living close to TV towers, the Committee is persuaded that a precautionary approach should be taken in siting base stations.

The Committee also notes the report of the UK's National Radiological Protection Board indicating evidence of a slightly increased risk of leukaemia in children living near high voltage powerlines.

Minimising the risk

The Committee Chair was disturbed at the lack of industry and government attention to developing lower-emission mobile phone technology or consumer advice about minimising exposure. The Committee found that the effectiveness of shielding devices and hands-free kits was at best unclear, that no standards or other regulations existed for these devices, and that whatever guarantees there were of mobile phone compliance with current standards, these became null and void with the use of such devices.

The Committee was concerned to find that there was no complaints or referral system in place for consumers experiencing health effects. Although some scientists and mobile phone manufacturers said it would be difficult to collect useful data, the Committee Chair supports the CSIRO's proposal for a 'register of health effects to systematically investigate and record reports of adverse health effects from mobile phone use' and an industry code of practice for handling complaints.

Funding of research and public information

Under its first term of reference, the Committee examined the allocation of funding from the Commonwealth's \$4.5 million radiofrequency electromagnetic emissions fund for research and public information (the RF EME program). This program consists of three components: an Australian research program, a contribution to the World Health Organization Electromagnetic Field Project, and a public information program.

The major criticism of the research program was that funds were inadequate. Of the \$4.5 million RF EME program, \$3.4 million was allocated for Australian research,

\$131,000 spent to June 2000 on public information and \$US50,000 per annum on the WHO International EMF Project. The \$4.5 million was collected from a one per cent levy on radiocommunications licences over a five year period which ends in 2000-01.

The RF EME program has funded six studies to date (including one a completed pilot study) which are detailed in Chapters 2 and 3.

The National Health and Medical Research Council (NHMRC) has the responsibility for awarding grants for this program and the Committee examined the funding allocation and criticisms that scientists who had found health effects of electromagnetic radiation were overlooked for funding, the length of time taken to get research results, the fact that the public information program had proceeded ahead of the research and accusations that there was an industry bias in the allocation of funds.

Submissions argued that in the light of identified gaps in knowledge of health effects, the need for replication, the cost of research, particularly animal studies, the value of the mobile phone industry, the significant revenue earned by government from the industry and the large number of people exposed, that a much larger sum should be available on an ongoing basis.

Counter arguments were made by the NHMRC to the effect that the program was consistent with amounts awarded in other areas of medical research, that a higher level of government funding would mean other projects would not be funded. It said that setting priorities for research spending was ultimately a social or political decision.

The NHMRC had reservations about the small number of researchers in this field being available to take up significantly more grants but acknowledged that one-off funding did not encourage specialisation.

There was general agreement on the need for research funding to be at arms-length from industry and whilst generally finding no fault with the NHMRC's processes, the Committee Chair was critical of the fact that Motorola employee, Dr Ken Joyner, is a member of the NHMRC's Radiofrequency Electromagnetic Energy Expert Committee and involved in the grant awarding process. Despite assurances that this role is a non-voting one, the Committee Chair is of the view that it is nonetheless an influential role and that for the sake of public confidence in the program, all members should be quite independent of industry.

The RF EME program was criticised as piece-meal, too scattered across institutions and lacking in structure and strategic planning.

The Committee Chair is not in a position to judge the quality or relevance of current research but does accept that more money should be available for research and recommends that a levy of \$5.00 be raised from each mobile phone user annually, the bulk of which should fund a structured program of research and a specialised research unit set up within the CSIRO for this purpose. The Committee Chair also recommends maintaining the NHMRC administered research program at \$4 million per annum from the levy.

Details of the World Health Organization Electromagnetic Fields Project are outlined in Chapter 2.

Public Information

The Committee heard from witnesses that lack of information on the potential risks associated with electromagnetic radiation and the failure to provide information on research findings denied the public the opportunity to make informed decisions.

The Committee holds the view that the Public Information Program has not been successful in informing the public, evidenced by the fact that many do not believe the information that is provided by government and its agencies. The Committee recommends that the Committee on Electromagnetic Energy Public Health Issues (CEMEPHI) website is regularly updated to reflect ongoing developments in research and standard setting.

The Committee found the so-called low-impact facility determination especially to be a cause of community dissatisfaction. Although radiation from mobile phone towers is considered to be potentially less harmful than mobile phones, the continuous exposure from towers, and the involuntary nature of that exposure have generated considerable public concern.

The Committee Chair recommends that the Government review the Telecommunications (Low-impact Facilities) Determination 1997 and ensures that a robust precautionary approach is included in the new Code of Conduct currently being devised by the Australian Communications Industry Forum (ACIF).

The Committee considers that other approaches to improve community understanding and participation should be facilitated, including conferences discussing research on the health effects of radiofrequency radiation and a centralised complaints mechanism for members of the public to report perceived health effects from mobile phones, the data from which can be used in determining research funding priorities.

Australian Standard

The Committee's terms of reference (c), (d) and (e) relate to the Australian Standard which deals with human exposure to electromagnetic emissions as it applies to telecommunications. Chapter 4 maps the history of standard setting in Australia and examines in particular the proposal to relax the Australian standard for exposure in line with the ICNIRP Guidelines and the refusal of the responsible Standards Australia TE/7 Committee to agree to that proposal, and the subsequent transfer of that responsibility to ARPANSA.

Central to the question of the adequacy of our standards was whether or not they dealt with non-thermal emissions. Dr Michael Repacholi advised that the scientific studies on which our standards are set were observations made in the 1970's of behavioural change in primates exposed to heat-emitting devices.

During the 1950's, dosimetry – the science of measuring exposure – was developed for non-ionising radiation and the concept of specific absorption rate (SAR) established. SAR is the rate of absorption of radiofrequency energy in a unit mass of tissue. A SAR of 4 watts per kilogram was settled on as a level of exposure that could result in a rise in core body temperature of up to 1°C.

Evidence presented suggested that this was a relatively basic idea of preventing core body temperature increases, given the complexity and variability of the resonant properties of the human body, and that the development of standards since that time had been somewhat arbitrary and inadequate in dealing with the effects which could be observed but which could not be explained by thermal effects.

The 1985 Australian Standard did however take a more conservative approach to setting exposure levels than the American National Standards Institute, choosing lower exposure levels for the higher and lower frequency ranges and an averaging time of one minute for all exposure conditions rather than the US six minute averaging time. This approach was said to acknowledge the possibility of harmful non-thermal effects.

Witnesses suggested that since 1985 the Australian Standard has come under sustained industry pressure to revert to much higher levels of exposure; to delete references to fundamental principles of radiation safety; to minimise any explicit references to harmful effects; and to delete the previous acknowledgment of the existence of non-thermal effects on living organisms.

A periodic review of the 1990 Standard was begun in 1993 but the TE/7 Committee would not agree to proposals put forward by industry to significantly increase allowable exposure limits. Nevertheless, an Interim Standard was introduced in 1998, based on International Radiation Protection Association SAR guidelines but covering an extended frequency range down to 3 kilohertz.

The Interim Standard was criticised as establishing exposure limits to suit mobile phones that failed to comply with previous public safety exposure standards.

Industry generally advocated that Australia's standards should be in harmony with world wide standards but the CSIRO observed that the 1985 Australian Standard was in place for more than 12 years and had not inhibited the introduction of new technologies and that furthermore, lower standards could have the effect of encouraging technological excellence.

The Committee Chair concurs with the CSIRO's view that relaxations of the 1985 Australian limits over much of the frequency range and averaging measurements over six minutes do not represent progress in dealing with non-thermal effects and are not warranted.

The Committee Chair also agrees that the standards should continue to include the precautionary principle and the principle that all possible efforts should be made to keep exposures as low as reasonably achievable (ALARA) below prescribed limits.

The Committee Chair is critical of the decision to transfer the standard setting process to ARPANSA, preferring the process used by Standards Australia and in particular, the involvement of the CSIRO and community representation and a voting system which provides for public health protection to be given appropriate weight against industry considerations. The Committee Chair notes that voting procedures in the ARPANSA working group are unclear and, in any case, lack of consensus will cause the Standard to be referred to the Radiation Health Committee for ratification which the Committee Chair regards as inappropriate.

Chapter 4 also deals with concerns about the designation of mobile phone towers as so-called low-impact facilities on the basis that the impact relates to visual and not planning, heritage, or health considerations. It examines proposals for labelling of phones, criticisms of testing and compliance frameworks for phones and shielding devices, occupational standards, and criticisms relating to the composition and processes of the ARPANSA Working Group set up to formulate the new standard.

Senator Lyn Allison
Chair

