Ann. Telecommun. (2008) 63:5–9
DOI 10.1007/s12243-007-0015-0

BRIEF REPORT

Emerging EMF technologies action on possible health risks

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Received: 15 November 2007 / Accepted: 27 November 2007 / Published online: 25 January 2008

Abstract In recent years, there has been an unprecedented increase in the use of devices emitting electromagnetic fields (EMF). This impinges on every aspect of day-to-day living, whether in the home, in public places or at work. While the benefits to society of such technologies, for example in mobile and other personal radio-communications, are accepted, significant public and media concern continues to be expressed about increases in EMF exposure of people and potential-related adverse effects on health. Particular concerns are focussed on what people often regard as the involuntary aspects of EMF exposure and often on the exposure of children or the unborn child. The key to addressing anticipated public and media concern about potential adverse health effects is foresight in respect of carrying out, co-ordinating and sharing knowledge of relevant multidisciplinary scientific research. This prompted a successful submission to the European Co-operation in Science and Technology (COST) programme for support for an Action entitled "Emerging EMF Technologies: Health Risk Management". The four-year Action in the COST Domain "Biomedicine and Molecular Biosciences" will provide researchers with an effective vehicle for sharing multidisciplinary knowledge, encouraging multi-laboratory collaboration and for training of early-stage researchers in EMF health-related research. It facilitates identifying how existing technologies change, what entirely new applications and services are introduced, what impact these would have on the levels and spectral nature of EMF exposure of people and what potential health consequences might arise.

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Keywords Electromagnetic fields · Health risks · Exposure · European projects

1 Introduction

The use of devices emitting electromagnetic fields (EMF) ranging from static to microwave frequencies has significantly increased in recent years. Their presence has affected almost every aspect of day-to-day living, at home, while travelling and at school, college and work. By far, the most significant impact has been through the rapid expansion of personal mobile telecommunication and wireless network systems for voice, picture and video communication, internet access and other data transfer applications. Other applications of EMF are found in the widespread use of electronic article surveillance, radiofrequency identification, metal detection and inductive heating devices. New digital public and commercial radio and television broadcast systems are currently being introduced throughout Europe. Applications in medicine abound, including advances in novel magnetic resonance imaging (MRI) equipment design and new MRI scanning techniques. There is also a potential for new medical applications of ultra wide band (UWB), for example in cardiology, detection of breast tumours, detection of intracranial haemorrhage and the use of implantable sensors that rely on UWB communication.

While the benefits of technologies that have already been introduced are clear and widely accepted by society, significant concern continues to be expressed about consequential increases in EMF exposure of people and potential-related adverse health effects. Generally, in the public arena, concern has been often expressed about potential effects of EMF exposure on children's health and on that of older and/or sick people and pregnant women (including the

unborn child). This is exemplified by public and media concern about the potential adverse health effects that might result from the exposure of young people through the rapid expansion of the use of WiFi systems in schools and colleges.

In contrast, in one important occupational setting, concern has been expressed by medical practitioners and other clinical staff using MRI for diagnosis and for research and by those concerned with the manufacture, calibration and maintenance of MR equipment, over the likely adverse effect on working practices and patient care of the implementation of the EC Physical Agents Directive. The clearest trend in MRI is the move to systems utilising higher field strengths, with 3-T installations accelerating and moving into clinical rather than solely research settings. The use of high and ultrahigh systems for structural and molecular imaging will increase particularly in the study of degenerative neurological diseases, high-resolution vascular imaging, detailed monitoring of the effectiveness of anti-angiogenetic and genetic-based drugs for the treatment of cancer. MRI is increasingly being used for physiological and metabolic investigations, and molecular applications such as quantitative imaging of gene expression, marking stem cells and tracking their evolution or monitoring targeting of malignant cells with targeted contrast agents. There may be some interest in new low field systems that are more 'patient-friendly', e.g. superconductive open scanners at 1 T or very short-bore 1.5-T cylindrical systems, which would normally complement an existing 1.5-T installation. At present, these systems are relatively expensive, but there are already a number of such installations in Europe. Low field, open scanners are often used in interventional MR.

It is clear that there is generally a paucity of data on these and other occupational exposures, and that experimental and computational studies are needed to resolve these issues.

Against this background, a successful submission was made to the European Co-operation in Science and Technology (COST) programme for support for an Action entitled "Emerging EMF Technologies: Health Risk Management".

The Action, in the COST Domain "Biomedicine and Molecular Biosciences", has been developed by and represents a consensus of scientific experts covering the disciplines of medicine, epidemiology, biology, physics, engineering and risk assessment and management. Experts from some 27 European countries have expressed interest in the Action.

Through key individual experts, the Action will also enjoy co-operative interaction with a number of national and international agencies including the World Health Organization (WHO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

The European Commission, national governments and international advisory bodies, such as the World Health Organization, have all recognised the importance of high-quality scientific research as fundamental to addressing such concerns and the Action will effectively facilitate the ongoing exchange of information and the results of such research and provide information that can be transposed by relevant authorities into sound health risk management based on scientific evidence. The Action will also contribute to the training of early-stage scientists in respect of supporting their interaction with more experienced scientists and the skills and knowledge transfer that ensues. In this regard, the Action plans for short-term scientific missions where early-stage researchers may seek support for working in established centres of relevant scientific expertise elsewhere. Scientists from new EU member states will have the opportunity to further collaborate and share experiences and knowledge in the field.

2 Current position

International co-ordination of activity in EMF-related scientific research and health risk management has been significantly improved by the activities of previous COST actions in this field, particularly COST Action 281. Through effective multidisciplinary scientific collaboration, major improvements in providing stakeholder-specific information for health risk communication will be possible. There are many partners contributing to this process including WHO, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and national agencies and advisory bodies. In Europe, one such anticipated partner is "EMF-NET". The roles of the COST Action and of such other bodies are complementary but distinctly different. COST provides a forum for expert scientific discussion, knowledge sharing and research collaboration at the grass roots level of scientific research, while interpretive and advisory bodies, including EMF-NET, deal principally with the interpretation of the science and dissemination of scientific review reports. The Action seeks to build upon and strengthen this co-operative complementary approach with other bodies.

3 Objectives

The main objective of the Action is to create a structure in which researchers in the field of EMF and health can share knowledge and information on:

– How existing EMF technologies change either in their operating characteristics or in novel ways and applications in which they are used.

- Identifying what entirely new EMF technologies are introduced and on what timescale.
- What novel emission and operating characteristics might result and what impact these would have on the device-specific and overall EMF exposure of people.
- What possible health effects could consequently arise and the scientific evidence for health concerns if any.
- How such concerns should be addressed through the use of evidence-based information.
- What tools are effective in communicating and managing such risks and perceived risks. And, effectively publish all such information in the public sector for the benefit of all stakeholders.

The secondary objectives are:

- To facilitate multidisciplinary co-operation and knowledge sharing amongst EMF and health researchers across Europe, and include new researchers in the process, in particular those from new EU member states. Emphasis will also be placed on helping early-stage researchers, including post-graduate students, to present and discuss their work and learn from experienced researchers in the various fields of activity. Primary end users are scientific researchers.
- To enlarge the field of co-operation to other disciplines. This to include researchers in wireless engineering, sensor development, medicine, epidemiology, biology, dosimetry, risk analysis, communication and public health. Primary end users are scientific researchers.
- To identify where answers to addressing health issues related to emerging technologies require additional research effort and provide early warnings of problems ahead. Primary end users are the general scientific community and academic institutions across the EU.
- To provide scientific information that can be used by international and national advisory bodies in producing interpretive and advisory documents. Primary end users are the EC, national government agencies and advisory bodies and manufacturing and service industries.
- To further develop EMF exposure measurement and computational techniques and facilitate multidisciplinary collaboration between epidemiologists, biologists and dosimetrists in quantifying EMF emissions and exposures of people. Primary end users are scientific researchers.
- To share the results of ongoing epidemiological, medical and biological EMF research including experience with novel biological techniques. Primary end users are scientific researchers.
- To share knowledge of methods and tools for assessing public risk perception of emerging EMF technologies. Primary end users are national and local government agencies, advisory bodies, risk assessors and communicators.

4 Programme

The initial focus will be on those existing EMF technologies where there is already concern about their use and where further developments in respect of their applications are foreseen in the shorter term. These include:

- *WiFi*—and more generally wireless networks—particularly in respect of their mass roll-out across Europe in schools, other educational establishments and elsewhere, and the potential exposure of young people. Research is ongoing on exposures from WiFi and similar EMF technologies, including WiMax, baby alarms and monitors etc. This is a complex issue due to the variable proximity of such devices and the efficiency of coupling of EMF with the body. To be effective, research effort must involve the manufacturers and providers of such equipment, experienced RF measurement experts and the co-operation of users, such as schools and colleges. It is important that the results of such research are shared and their implications discussed as early into the Action as possible.
- *MRI*—where there is already considerable research in progress in assessing occupational exposures to medical staff and to patients and volunteers. Increases in specialised MRI techniques, such as cardiac imaging and interventional procedures, will lead to the emergence of greater numbers of specialised medical units with further uncertainties in exposures of staff. It is important that the results of dosimetry and other studies are shared and discussed in respect of assessment of compliance with the EU Physical Agents Directive and in national and European policies for the care of patients and volunteers undergoing MRI procedures.
- *Electronic article surveillance and RFID devices*—where the International Commission on Non-Ionizing Radiation Protection (ICNIRP), in a report commissioned by the EU, recommended the measurement of levels of exposure. Such exposures include those to workers and to the general public (including children). For this, and for other exposure characterisation purposes, the further development and dosimetric application of anatomically realistic computational phantoms, including those of children, based on medical imaging data is recommended. ICNIRP emphasised that, in the development of security systems, minimisation of exposures should be considered as a primary design criterion. It is important that the results of such scientific work should be shared and discussed, and the Action provides an effective vehicle for this.

Under the guidance and monitoring of a Management Committee, the focus will subsequently shift to identify

those EMF technology applications and services currently in use and/or likely to be rolled out over future years and, where possible, to characterise likely exposures and identify potential health concerns associated with their use. Likely candidates might include, for example: so-called 4G (and further developments in mobile telephony), ad hoc networks, W-LANS, WiMax, Zigbee, Bluetooth, Wimedia, UWB, broad-band over power transmission lines, various EASD and RFID applications and further digital broadcasting.

In parallel with these activities, horizon scanning will be carried out of devices and applications at present in concept stage, with the purpose of advising engineers, designers and those responsible for marketing and rolling out EMF systems and products to consider exposure of people and possible health concerns in their development plans.

In the fields of epidemiology and biology, the primary focus will be on keeping up to date with and sharing information on ongoing studies relevant to EMF exposure and health and interpreting the results in relation to the nature of possible exposures related to emerging technologies.

Innovative biological techniques are also of interest, and it will be proposed to the Action Management Committee that the Action should keep abreast of developments in the area of High Throughput Screening Techniques (HTST) applications in studying low intensity exposure to EMF by:

- Analysing new relevant scientific publications.
- Preparing a set of good scientific practice guidelines for scientists who are executing HTST studies in EMF research in order to help in increasing the scientific quality of the studies.
- Developing a database where information from HTST analyses could be stored and used as reference in designing new studies that would look at physiological effects of EMF.

5 Benefits

The benefits of the Action are in:

- Identifying emerging EMF technologies, applications and services and, in advance of their roll out, elaborating the basis for answers to health-related issues of potential concern, thus providing the opportunity for pre-emptive actions on product design, policy development, etc.
- Sharing knowledge of likely emissions and exposures of people associated with the use of such technologies, thus enabling comparison with exposure standards for the general public and occupational exposure limits and the opportunity for pre-emptive advice and, if necessary, controls on their use.
- Providing information on ongoing life science studies and assessing the potential for emerging biological investigation techniques for application to EMF health risk investigations.
- Providing scientific information to assess the likely impact, if any, on health from the use of such technologies, thus supporting policy development as to their use in society.
- Providing scientific and technical information supportive of health risk assessment, risk communication and planning future research.

The vehicles for dissemination include scientific reports from working groups and proceedings of workshops and conferences, peer reviewed papers, a newsletter and an Action website.

6 Beneficiaries

The Action will be of significant benefit to:

- *Researchers*—in respect of sharing information on ongoing research multidisciplinary forums, early identification of research gaps and needs, encouraging opportunities for international collaboration and co-publication and, for early-stage researchers, the opportunity to acquire relevant further experience, skills and knowledge.
- *Risk managers and communicators*—in providing multidisciplinary forums to share complementary knowledge with scientific researchers supporting the development of health risk communication strategies.
- *EU and national and local government officials and elected representatives*—in their task of developing proportionate policies to minimise health risk in the face of often technically complex and apparently conflicting health information.
- *International health protection advisory and technical standardisation organisations*—in providing scientific information on EMF and health related to emerging technologies, useful to the work of bodies such as WHO, ICNIRP, CENELEC, IEC, etc.
- *Industry and commerce*—in respect of having the information to judge whether there is likely to be adverse public and media concern about their products and services before launching them, to consider likely EMF emissions and exposures of people at an early stage of product design and development.
- *Society as a whole*—in ensuring that, when new EMF technologies are introduced, potential risks are seen in perspective with the benefits. This supports open communication and dialogue based on facts rather than ‘beliefs’.

– *The media*—in making available facts about new EMF technologies in order to inform their readers/viewers/listeners.

7 Administration

The Action is structured around the co-ordinated activities of specific Action Working Groups and through cross-group tasks. Initially, it is envisaged that the Action Working Groups will comprise:

– *EMF Measurement and Monitoring*—This group will maintain a watching brief to identify and report on new technologies utilising different parts of the frequency spectrum. It will contribute to the further development of EMF measurement techniques appropriate to existing and new technologies and provide exposure data for both public and occupational situations.
– *Computational Dosimetry*—This group will contribute to the further development of EMF computational dosimetry techniques for existing and new technologies including (statistical) uncertainty management for both public (including children's) and occupational exposures. These activities are vital to quantifying exposure of people its spatial distribution within the body.
– *Epidemiology*—This group will address epidemiological research and will analyse and discuss the outcomes of studies.
– *Biology*—This group will cover ongoing biological research studies including novel biological investigational methods with potential application to EMF and health research.
– *Risk Communication and Management*—This group will share multidisciplinary scientific knowledge in identifying and assessing methods and tools for use in health risk communication and management.

8 Collaboration

International co-ordination of activity in EMF and health risk management has been significantly improved by the complementary activities of a previous COST Action 281 and those of international and national interpretive and advisory bodies. COST provides a forum for expert scientific discussion, knowledge sharing and research collaboration at the grass roots level of scientific research, while interpretive and advisory bodies deal principally with the interpretation of the science and dissemination of scientific review reports. The Action will seek to build upon and strengthen this co-operative complementary approach with other bodies.

In conclusion, as with all COST actions, the focus in this Action is on active collaboration and communication between scientists and other relevant professions at the research working level. Anyone interested in participating in the Action is encouraged to contact the author for further information.

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