

Possible Health Risks to the General Public from the Use of Security and Similar Devices



**Executive Summary of the Concerted Action QLK4-1999-01214
“Development of advice to the European Commission on the risk to
health of the general public from the use of security and similar devices
employing pulsed and continuous electromagnetic fields”
Fifth Framework Programme of the European Commission, Quality of
Life, Key Action 4: “Environment and Health, Health impact of
electromagnetic fields“**



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Scope

The objective of this executive summary is to address the possible adverse effects on public health from exposure to pulsed and continuous wave (cw) electromagnetic fields (EMFs) associated with the use of electronic security and similar devices. The document summarises the results of the Concerted Action QLK4-1999-01214 “Development of advice to the EC on the risk to health of the general public from the use of security and similar devices employing pulsed and continuous electromagnetic fields” within the program Quality of Life (QoL), Key Action 4 “Environment and Health” of the Fifth Framework Programme of the European Commission (EC) (full report: ICNIRP 12/2002, ISBN: 3-934994-01-6). The document will provide advice to the EC and European Members States as an input to policy development. Secondary objectives include: a review of the scientific evidence of possible harm to human health from EMF exposure relevant to fields at the operating frequencies of such devices; a review of the applicability and limitations of currently available exposure assessment techniques and recommendations for future health risk assessment and research priorities.

Characteristics of systems and devices

Electronic Article Surveillance (EAS), Radiofrequency Identification (RFID) and metal detector systems operate over a wide range of frequencies, using continuous wave or different pulse modalities. Emission frequencies for devices currently in use range from tens of hertz to several gigahertz. While individual systems generally use single frequencies or narrow bands of frequencies, future applications may also exploit combinations of different frequency bands used simultaneously (although not necessarily exactly time and phase coincident). There is a large global market for such devices. With regard to exposure of the general public it is important to note that EAS systems are likely to become ubiquitous in retail stores and together with low cost tagging of goods will become standard pieces of equipment at stores points of sale and checkouts. The applications of radiofrequency identification devices are also likely to increase, and perhaps include libraries, airline baggage checking and parcels and products transport and generally high value goods checking. The primary application for metal detecting devices is weapon discovery and metal object theft prevention. There is a need to further collect reliable emission data for these systems in order to improve the exposure assessment.

Exposure assessment

There is a wide and complex range of exposure situations related to the use of security and identification devices. The complexity is manifested by the number of different spatial and temporal characteristics of emissions (e.g. range of frequencies and pulse modalities) and by differences in the physical design of equipment.

A number of measurement and computational dosimetric tools are currently available to carry out health related exposure assessments. However, there is a need to further develop such tools, particularly computational methods. While anatomically realistic computational phantoms for adult males have been used to provide exposure data over a wide range of frequencies and exposure situations, few such data are available for adult females or for children. Given the widespread use of security and identification devices in areas where the general public has access to, exposure of women and children is most relevant. It is, therefore, important that computational tools specifically addressing differences in body size, anatomy and age are further developed.

Mechanisms

There are different thermal and non-thermal interaction mechanisms by which electromagnetic fields can interact with biological systems. Three sets of phenomena (heating, membrane stimulation, and electroporation) are responsible for most of the established hazards from acute exposure to electromagnetic fields. Because of the weak coupling between external fields and the body, these generally require relatively high field strengths or currents to be passed directly into the body.

Comparing the thresholds of these effects is complicated by the fact that they vary in different ways with frequency or pulse width. Electroporation requires high membrane field strengths, and is a very fast process. Membrane excitation requires somewhat lower membrane potentials and is also a fast process (milliseconds). Thermal damage is a much slower process, both because of the thermal inertia of the process and because of the kinetics of thermal damage itself. In general, the hazards from low-frequency fields are associated with membrane effects and those from high frequency fields are associated with heating. Electroporation has no relevance in everyday exposure situations.

Between 100 kHz and about 20 MHz a transition from membrane effects to heating effects occurs. Many other mechanisms of EMF interaction with biological systems have been proposed, most directed at observed low or high frequency effects that cannot be readily explained in terms of the classical mechanisms. However, up to now no such mechanism with relevance for security systems has been established. ICNIRP's basic restrictions accommodate all known biophysical mechanisms in the EAS/RFID range.

The EAS/RFID fields will produce no heating and no thermoregulation stress. There are also no relevant contact currents. Although, it is known that pulsed EMF's produce more excitations and less heat, there is little evidence that pulsed fields are more efficient than continuous electromagnetic fields in eliciting effects in the EAS frequency range. Specific effects of high peak powers are not relevant to EAS.

Epidemiological studies

Childhood leukaemia is the only cancer for which there is a statistically consistent evidence of an association with postnatal exposures to low frequency magnetic fields above 0.4 μT . The evidence for a causal relationship is, however, not conclusive. Nevertheless, the International agency for Research on Cancer (IARC) has concluded that low frequency magnetic fields are possibly carcinogenic to humans, based on a consistent statistical association of high level residential magnetic fields with an increased risk of childhood leukaemia, by approximately a factor of two.

The few studies examining brain cancer and residential exposure in adults have found little or no evidence of an association.

Most studies exploring the link between EMF and adult cancers have been based on occupational groups with possibly high exposures. Among them, a number of studies that have reported an increased risk of leukaemia for electrical workers. Some occupational studies indicate also a higher risk of brain cancer for workers in electrical occupations. All of these studies suffer from methodological weaknesses especially with respect to exposure determination.

The available epidemiological studies investigating effects of EMFs on human reproduction all have limitations that prevent drawing clear-cut conclusions. Because of the lack of data no conclusions can be drawn especially for radiofrequencies and microwaves. With regard to the totality of scientific knowledge, there is no convincing evidence today that occupational or daily life EMF exposure of pregnant women or potential fathers do any harm to the human reproductive process.

Human laboratory studies

In the low frequency region (up to 300 Hz), stimulation effects produced by surface electric charges due to low frequency electric fields can be perceived by people. Electrically excitable cells in the retina can be affected by current densities of 10 mA m^{-2} or more, induced by low frequency magnetic fields or directly applied electric current, but with no known adverse effect on health. International guidance on limiting human exposure (ICNIRP, 1998) seeks to limit the annoying effects of surface charges and avoid adverse effects of induced current on the neural circuitry of the retina and other parts of the central nervous system.

Generally, below these levels of exposure, no consistent effects have been found in either animal or volunteer studies. In particular, there is no convincing evidence of any effect on reproduction and development, on haematology or the immune system or on carcinogenesis.

In the frequency region 300 Hz to 10 MHz, often referred to as the intermediate frequency region, the threshold for effects of induced current on electrically excitable cells in the central nervous system will only predominate over possible heating effects at low frequencies (up to about 100 kHz). As frequencies increase from about 100 kHz to about 10 MHz, heating effects become dominant, depending on other exposure conditions (e.g. pulse modality). International guidance (ICNIRP, 1998) in this region is based on the extrapolation of neural tissue thresholds identified in the low frequency region according to the known frequency dependence of nervous tissue responses, and the heating effects identified at frequencies greater than 10 MHz.

In the high frequency region (10 MHz – 300 GHz), heating effects are well established in volunteer and animal experiments. International guidelines on limiting exposure to electromagnetic fields (ICNIRP, 1998) seek to prevent adverse effects of excessive whole-body and localised heating. In addition, guidance is given concerning the avoidance of the annoying auditory perception of pulsed EMF. There are no established adverse health effects below these levels of exposure, although the possibility has been raised in connection with mobile phone radiation that there may be subtle transitory effects on nervous system function and behaviour.

Animal and cellular studies

A large number of animal studies have been carried out at low and high frequencies. Many have focussed on effects on the nervous system and behaviour or on possible effects on carcinogenic processes. However, most indices of general physiological status appear relatively unaffected by exposure and there is at present no convincing evidence of adverse health effects for humans or animals. In contrast, at intermediate frequencies, few studies have been carried out and the scientific literature is scant.

With regard to cellular studies, the possibility that there are subtle biological effects due to low frequency exposure cannot be ruled out. However, the results that are claimed to demonstrate a positive effect of exposure tend to show only small changes whose biological and adverse health consequences are not clear.

In the intermediate frequency region, few cellular studies have been carried out; the evidence to date concerning signal transduction, protein expression and cell proliferation, is largely contradictory.

High frequency radiation can affect cellular processes when sufficiently intense to induce heating. Generally, however, exposures from security and similar devices are at levels many times below those that would induce a physiologically relevant heating.

Electromagnetic interference with medical devices

Electromagnetic interference between the emissions from security systems and medical that results in clinically significant effects happens relatively infrequently and thus does not appear to be a major public health problem. However, there are several dozen incident reports suggesting that certain types of electrically powered active medical devices, worn by people who are ambulatory and may pass through security systems, can have their medical function disrupted by the emissions from the security systems. In addition, there are several hundred records of interference of medical devices with security systems, including both clinical data and in-vitro laboratory studies designed to deliberately provoke such interactions. The reported cases of electromagnetic interference with certain critical medical devices remain a concern.

Recommendations

Characteristics of systems and devices

- The identification of possible risks to health from the use of such devices depends on the availability of information on their operating characteristics, specifically their operating frequencies, intensity of the produced electromagnetic field, details of their physical design and the pulse modalities used. There is a need to continue to measure levels of exposure to people passing security systems and at work places near security systems.
- There is also a need to collect exposure data about RFID systems. When such technical information becomes available during the development of a new product or application, a health hazard assessment should be undertaken to identify likely problems in complying with exposure guidelines. Awareness of the magnitude of the likely exposure of people as a result of the envisaged use of a system should be an integral part of the development process.
- Information relevant to a health hazard assessment on a particular system should be provided to the purchaser by the manufacturer.

Exposure assessment

- Support should be provided for the further development and dosimetric application of anatomically realistic computational phantoms based on medical imaging data – such phantoms should include adult male and female phantoms and child phantoms at different stages of growth.
- Support should be provided for experimental studies measuring the dielectric properties of relevant body tissues. Such studies should address all frequencies of relevance to the practical exposure of people and the variations of dielectric properties as a function of age.
- Where measurements and/or calculations are made to assess the exposure of the general public, they should include assessments of the exposure of children.

Electromagnetic interference with medical devices

It is recommended that the following actions are taken to address the issue of medical device electromagnetic interference (EMI) by security systems.

- There is a need to minimise the risks of EMI caused by emissions due to security systems. In this respect, it is recommended that the development of security systems should address as far as is practical the minimisation of exposures as a quality criterion.
- There is a need for more knowledge about how such devices interact with the emissions and how to design

and test both medical devices and emitting equipment to reduce their risks of EMI. A European forum should be established to continue and enhance the collaboration between the medical device and security system industries, with physician input. Further, this forum will enable manufacturers of medical devices and security systems to provide sufficient information about current and new products so that both industries can work to minimise the risks of EMI caused by emissions from security systems.

- Medical device manufacturers should provide physicians and device users with information to make them aware of the possibility of EMI problems. This information should enable physicians to advise their patients about relevant EMI sources and means to minimise their risk. The security industry should address these risks in their product information and device labelling (such as recommended in the document “FDA Guidance for Labelling for Electronic Anti-theft Systems” August 15, 2000).
- One of the most appropriate routes for information to patients with medical devices is through their physicians or the responsible health care authorities. Comprehensive information for the medical device patient should enable them to be aware of the risks. Societies such as the European Society of Cardiology, etc. could be consulted for appropriate forms of advice.
- More data are needed on the emissions of EAS, RFID or metal detector systems and on the interference with all kinds of active implantable medical devices. The data must be publicly available so that the device

manufacturers, physicians, and patients can make informed choices.

- Further studies should be carried out on functional and technology imposed limitations of various medical devices, the characterisation and influences of emitted waveform types and the refinement of medical device electromagnetic field interaction models for security systems exposures. Compatibility between neurostimulators and other new developed devices and security systems should be tested.
- The ultimate goal should be for complete compatibility between the security systems and medical devices that may pass through the systems. The risk for the public, including medical device users, resulting from EMI from the security systems should be minimised. This task addresses standardisation bodies, manufacturers of emitting devices and manufacturers of active implantable medical devices. It will be necessary for product standards for emitting systems and for active implantable medical devices to both rely on the same limiting values concerning EMI problems. As long as older devices are still in use, means are needed to manage the remaining incompatibilities between existing emitting systems and existing active implantable medical devices. This task addresses authorities, system users, physicians and patients.

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