

'workers at particular risk' and of health surveillance of exposed workers.

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#### 1649a ILO ACTIVITIES FOR THE PREVENTION OF THE RISK RELATED TO OCCUPATIONAL EXPOSURE TO EMF IN WORKERS

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**Introduction** Hazards of non-ionising electromagnetic radiation (EMF) and risks from occupational exposures to them have been an increased concern to the ILO in particular over the last three decades. The health implications of over exposure to EMF are well documented in the scientific literature, such as injuries caused by leakage from microwave ovens or radio-frequency, and in some countries acute health effects of EMF can be considered occupational injuries. On the other hand there is only very limited scientific evidence presently on the diseases possibly caused by EMF exposure in workers. The ILO uses various means of action to give governments and employers' and workers' organisations the necessary help in drawing up and implementing programmes for the control of workplace risk factors, including EMF, as international standards in the form of legal instruments, codes of practice, practical manuals, training materials and education and training and technical cooperation. The ILO has collaborated with the ICNIRP and the WHO in the development of several practical guides and reports, including: Occupational Hazards from Non-Ionising Electromagnetic Radiation (ILO OSH Series No. 53), Protection of Workers From Power Frequency Electric and Magnetic Fields (ILO OSH Series No. 69), Visual Display Units: Radiation Protection Guidance (ILO OSH Series No. 70), and Safety in the Use of Radiofrequency Dielectric Heaters and Sealers (ILO OSH Series No. 71). These tools provide guidance on workplace safety and health measures and procedures that will lead to higher standards of safety for all personnel engaged in the operation which gives rise to occupational exposure to non-ionising radiation. The ILO also collects information on good workplace practice on protection of workers against non-ionising radiation and on the identifications and recognition of diseases as occupational caused by non-ionising radiation and provides support for the applications of the relevant ILO instruments in member States.

#### 1649b EU DIRECTIVE 2013/35/EU ON OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELDS

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**Introduction** Directive 2013/35/EU of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields (EMFs)) was published in 2013. The directive gives minimum requirements for the protection of workers from risks to health and safety arising from exposure to electromagnetic fields (0 Hz to 300 GHz). The aim of this paper is to describe the directive and how it has been implemented into practice.

**Methods** New guidelines have been written by different countries of the EU. Measurements and evaluations of EMFs have been conducted. High field values have been searched, and risk analyses for EMF exposure have been performed.

**Results** For example, the following topics have been proposed in new guidelines: offices, nuclear magnetic resonance (NMR) spectrometer, electrolysis, medical devices, engineering workshops, automotive industry, welding, metallurgical manufacturing, radiofrequency (RF) plasma devices, rooftop antennas, walkie-talkies, and airports. Evaluation criteria for the current is 100 A, and for the voltages, 100 kV. There are also evaluation principles for active implanted devices, and there are guidelines on distance attenuation principles of EMFs.

**Discussion** There has been progress in implementing the directive. However, small and medium size companies have often limited resources to put toward evaluation and risk analysis. Protection against these fields can be technical, increasing distance, working processes, worker guides, or in some cases, personal protection devices. Health examination can also give in some cases information on excessive exposure (e.g., micro-waves). Documentation of the actions is probably lacking to some extent in risk analysis files.

#### 1649c THE PROBLEM OF THE WORKERS AT PARTICULAR RISK

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The directive 2013/35/EU on minimum health and safety requirements regarding the exposure of workers to risks arising from electromagnetic fields (EMF) states that the risk assessment and the implementation of preventive and protective measures have to take into account the workers at particular risk. Apart workers implanted with active or passive medical devices or wearing medical devices and pregnant women, the directive does not explicitly recognise other categories of workers at potential higher risk due to EMF exposure. Workers with active implanted medical devices (pacemakers in particular) are addressed by *ad hoc* technical standards (EN 50527–1:2010–04 and EN 50527–2–1:2011–05). In EU, active implantable and wearable medical devices must comply with requirements specified in technical standards, usually followed by the manufacturers. However, despite the growing diffusion of the active implantable or wearable medical devices and their diversification in terms of types and medical indications, other technical standards specifically devoted to workers carrying these devices and exposed to EMF are not yet available. For passive implanted medical devices, the risk assessment has to be performed mainly based on the available scientific literature. The case of pregnant women deserves special considerations while biological and pathological conditions making the worker at potential higher

risk with respect to other workers at comparable exposure levels are still object of debate. Overall, the topic of workers at particular risk exposed to EMF is an open question and has to be managed case by case using a combination of information sources: directive itself, exposure assessment in the workplace, technical standards, findings of workers' health surveillance, information acquired by the general practitioner or specialists having in care the worker, data from the manufacturer of the devices (e.g. technical sheets or instruction manuals), scientific literature etc.

#### 1649d WHAT HEALTH SURVEILLANCE OF EMF EXPOSED WORKERS?

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In the European Union (EU), the Directive 2013/35/EU has introduced the legal obligation of an 'appropriate health surveillance' (HS) for workers exposed to electromagnetic fields (EMF). Until now no agreement exists on the criteria, and on the contents, of such an HS. The EU Directive specifically refers to the protection from the risks associated with known direct biophysical and indirect short-term effects caused by EMF, while does not address to the suggested long-term effects since scientific evidence of a causal relationship is considered not adequate. Accordingly, at least in EU Countries specific objectives of HS are:

- the prevention of established effect, such as the stimulation of muscles, nerves or sensory organs (including temporary annoyance or effects on cognition) and limb currents, or any thermal effects;
- the health and safety of workers 'at particular risk', e.g. workers with active implanted medical devices (cardiac pacemakers, ICD, insulin pumps, etc.) or pregnant workers; nevertheless a comprehensive definition of the conditions inducing a 'particular risk', and of the safe thresholds, are still lacking.

It should be noted here that the exposure limits introduced by the Directive 2013/35/UE do not necessarily provide an adequate protection of such workers, e.g. interference problems with pacemakers may occur at lower levels. HS is therefore mainly aimed to evidence the occurrence of clinical symptoms possibly related to EMF and the existence of conditions possibly inducing particular risk, while specific laboratory test are not required, except on individual clinical basis. As a conclusion, at present time no agreement exists on the health surveillance of EMF exposed workers, and knowledge on some aspects, e.g. the conditions inducing particular risk and the possible thresholds, are still insufficient, and do not give an adequate support to the occupational physician to face the problem.

#### 1650 MAGNETIC RESONANCE IMAGING (MRI) WORKERS: EMF EXPOSURE, OCCUPATIONAL RISK AND PREVENTION. AN UPDATE

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**Aim of special session** Magnetic Resonance Imaging (MRI) is an important technology both for diagnostic and research purposes. MRI operators are exposed to high levels of electromagnetic fields (EMF), mainly static magnetic fields and low-frequency time-varying magnetic fields (TvMF). Objective of this Special Session is an update of the results of research on the effects related to occupational EMF exposure in MRI operators, and on possible prevention.

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#### 1650a SUBJECTIVE SYMPTOMS IN MAGNETIC RESONANCE IMAGING OPERATORS: PRELIMINARY RESULTS OF AN ITALIAN STUDY

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**Introduction** Magnetic Resonance Imaging (MRI) operators are exposed to significant levels of electromagnetic fields (EMF). In these workers an elevated prevalence of various subjective symptoms has been reported. Even if most symptoms are non-specific, in some recent studies a group of 5 more specific symptoms, defined 'core symptoms', was proposed: vertigo, nausea, head ringing, magnetophosphenes and metallic taste. Our aim was to investigate the prevalence of subjective symptoms, including 'core symptoms', in Italian MRI operators, in order to evaluate the association with exposure.

**Methods** A sample of 152 MRI operators working in 6 different hospitals in Italy was collected. No measurements were available, so for each participant exposure was estimated based on scanner type (<1T, 1.5T –<3T and ≥3T respectively) and on the total number of MRI procedures followed. In all operators an *ad hoc* questionnaire including relevant sociodemographic and occupational data, and the occurrence of subjective symptoms based our previous experience, was collected. The influence of stress was also evaluated. The relation between occupational exposure and symptoms was studied using multivariate analysis.

**Result** The multivariate analysis shows a significant correlation between exposure level and the total number of investigated symptoms. The results were confirmed considering the specific subset of 'core symptoms' based on previous literature data. In the multivariate model, the weight of the other covariate factors was not significant. The overall results were substantially confirmed considering the effect of work stress.

**Discussion and conclusions** In the observed group of MRI operators the total number of subjective symptoms was associated with EMF exposure; the subset of 'core symptoms' also proved significantly dose-related with exposure. The symptoms