

**ACTIVITIES CONCERNING NON-IONIZING ELECTROMAGNETIC
RADIATION PROTECTION AT THE INSTITUTE OF PUBLIC
HEALTH OF IASI**

Cristian Goiceanu, Răzvan Dănulescu

Institute of Public Health, Iași, România

Abstract. During last decades, at international and EU level, the issue of health protection against non-ionizing electromagnetic radiation has shown an increasing interest. World Health Organization initiated projects on effects of exposure to electromagnetic fields and to ultraviolet radiation. The International Commission on Non-Ionizing Radiation Protection elaborated guidelines on limiting exposure to non-ionizing radiation. EU adopted Directives and Recommendations to limit human exposure to this kind of radiation. In Romania, before 1990, the issue of health protection against non-ionizing radiation focused on ultraviolet, infrared and lasers radiation. The first standard for occupational exposure to electromagnetic fields was adopted in 1996 and later, in 2002, regulations on general public exposure were adopted. At the Institute of Public Health of Iași, the topic of non-ionizing electromagnetic radiation protection has been addressed since 1992. In 1997, the Romanian Working group on Non-Ionizing electromagnetic Radiation Protection was founded in Iasi, based on a core from the Institute of Public Health of Iași. During last 15 years, our team has carried out many activities in this field: drafting exposure standards, calculation of exposure limits, determination of electromagnetic field levels, elaboration of procedures and methodologies for electromagnetic field measurement. A "Practical guide for electromagnetic field measurement at workplaces" was published in 2006. Moreover, our consultancy services on human exposure to electromagnetic fields are provided for various levels of society. Our team is also carrying out scientific research activities in this domain like epidemiological studies concerning health consequences of occupational exposure to electromagnetic fields. Moreover, experimental studies on animals exposed to electromagnetic fields have also been carried out. Scientists from our team have got involved in national and international research projects and, also, in EU Networking Projects such as EMF-NET Project and COST.

Key words: non-ionizing electromagnetic radiation, human exposure, health protection

Rezumat. În ultimele decenii, pe plan internațional și la nivelul UE, problematica protecției sănătății față de expunerea la radiații electromagnetice neionizante a prezentat un interes tot mai mare. Organizația Mondială a Sănătății a inițiat proiecte privind efectele expunerii la câmpuri electromagnetice și la radiații ultraviolete. Comisia Internațională pentru Protecția față de Radiațiile Neionizante a elaborat ghiduri privind limitarea expunerii la radiații neionizante. UE a adoptat Directive și Recomandări asupra limitării expunerii umane la acest tip de radiații. În România, până în 1990, problematica protecției sănătății față de expunerea la radiații electromagnetice neionizante s-a axat pe radiații ultraviolete, infraroșii precum și radiații laser. Primul standard pentru expuneri ocupaționale la câmpuri electromagnetice a fost adoptat în 1996, iar, mai târziu, în 2002, au fost adoptate norme pentru expunerea populației generale. În cadrul Institutului de Sănătate Publică din Iași, încă din 1992 a fost abordată problematica protecției față de radiațiile electromagnetice neionizante. În 1997, având ca bază un nucleu de specialiști din Institutul de Sănătate Publică din Iași, a fost fondat Grupul Român de Lucru pentru Protecția față de Radiațiile electromagnetice Ne-

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Ionizante. În ultimii 15 ani, echipa noastră a desfășurat multe activități în acest domeniu precum: elaborarea de proiecte de standarde de expunere, calcularea de noi limite de expunere, determinări ale nivelelor de câmp electromagnetic, elaborare de proceduri și metodologii pentru măsurarea câmpului electromagnetic. În anul 2006 a fost publicat un „Ghid practic pentru determinarea nivelelor de câmp electromagnetic din mediul de muncă”. Mai mult, serviciile noastre de consultanță privind expunerea umană la câmpuri electromagnetice sunt oferite pentru diverse nivele ale societății. Grupul nostru mai desfășoară și activități de cercetare în domeniu precum studii epidemiologice privind consecințele asupra sănătății ale expunerii ocupaționale la câmpuri electromagnetice. De asemenea, s-au efectuat și studii experimentale pe animale expuse la câmp electromagnetic. Specialiștii din grupul nostru s-au implicat în proiecte de cercetare naționale și internaționale și, de asemenea, în proiecte de coordonare ale UE precum EMF-NET Project și COST.

Cuvinte cheie: radiații electromagnetice neionizante, expunere umană, protecția sănătății

INTRODUCTION

Starting last century, human exposure to non-ionizing radiation (NIR) generated by man made sources continuously increased. Consequently, since seventies, a new domain developed: non-ionizing radiation protection (NIRP).

At international level, the organization coordinating the activities on non-ionizing radiation protection is the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is a body of independent scientific experts consisting of a main Commission, 4 Scientific Standing Committees (Epidemiology, Biology, Dosimetry and Optical Radiation) and a number of consulting experts in various disciplines: epidemiology, medicine, biology, physics and engineering. This expertise covers important issues of possible adverse effects on human health of exposure to NIR including static and time-varying electric and magnetic fields, radio-frequency and microwave radiation, the optical radiations (ultraviolet, visible, infrared and lasers), and ultrasound. By now, ICNIRP elaborated guidelines limiting exposure to electromagnetic

fields (EMF), to laser radiation, to ultraviolet radiation (UV), to incoherent optical radiation and to ultrasound (1, 2). World Health Organization (WHO) is much involved in two directions of NIR protection: EMF (3) and UV radiation. WHO established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz. The activity planned for 2007 in the framework of International EMF Project is WHO/ICNIRP health risk assessment of RF fields. The other WHO project on NIRP is INTERSUN and it assesses the scientific data on health effects of UV radiation.

In Romania, before 1990 the issue of health protection against NIR focused on UV, infrared radiation and lasers. However, since nineties, epidemiological and experimental studies have been conducted to determine possible effects of biological exposure to EMF. The first Romanian EMF exposure standard was adopted in 1996 in the case of occupational exposure and in 2002 for general public.

At the Institute of Public Health (IPH) of Iași, the topic of health protection against electromagnetic radiation has been addressed since 1992. Our activity in this field began with a small group of scientists involved in the study of the occupational exposure to radiofrequencies and microwaves, as well as in the assessment of the possible health effects of this kind of exposure. After five years of activity in this field, in 1997, as a result of our work and as an initiative of the group from IPH Iași, the Romanian Working Group on Non-Ionizing electromagnetic Radiation Protection (RWG-NIRP) was founded in the frame of the Institutes of Public Health of Bucharest, Iași, Cluj and Timișoara, coordinator being Dr. Răzvan Dănulescu.

SCOPE AND DOMAINS OF ACTIVITY

As mentioned above, the NIRP team within IPH Iasi also represents the nucleus of RWG-NIRP. Our group promotes the point of view of occupational and environmental health concerning the establishment of strategies as well as the implementation and control of programs dealing with health protection against exposure to non-ionizing radiation. The main purpose consists in the development of an active health protection policy by involving in risk assessment, risk management and risk communication related to non-ionizing radiation.

The main directions of developed protection activities are:

1. Establishment of a strategy and programs dealing with health protection against exposure to NIR, in agreement

with European policies, as well as the policy of surveying practical steps needed for implementing the strategy and the programs:

- to survey international and EU health protection policies, exposure standards and guidelines;
- to establish connections with international organizations dealing with assessment of risk and the development of guidelines on exposure to NIR;

2. Assessment and determination of NIR levels to which general public and occupational public are exposed.

3. Development of Romanian standards compliant with European Union requirements.

4. Scientific research promotion and direct involvement in experimental and epidemiological research concerning biological effects of NIR.

5. Provides scientific information and consultancy services for various levels of society.

Concerning the scientific research carried out by our team, the following research domains are of greatest interest:

1. Evaluation of human exposure to electromagnetic fields: measurement and calculation. Exposure metrics.

2. Biological effects of electromagnetic fields.

3. Human health effects of EMF exposure, assessed by means of epidemiological research.

4. Protective measures and exposure standards.

5. Dielectric properties of biological tissues.

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The next part of our paper will be dedicated to the background, working experience and main activities, studies, results, national and international collaborations of the NIRP group from IPH Iași.

BACKGROUND OF OUR TEAM MEMBERS

Our team includes experienced members in the protection and research domains mentioned above. The background of some members includes doctoral theses in this field, post-graduate training and stages in Universities and research laboratories:

• **Doctoral Theses:**

- “Epidemiological studies on Radiofrequency health effects in occupational exposure”, “Gr. T. Popa” University of Medicine and Pharmacy, Iasi, Romania, - defended publicly on 20.07.1998. (Dr. R. Dănulescu, MD, PhD)

- “Studies on the influence of electromagnetic fields on biological systems”, “Alexandru Ioan Cuza” University, Iasi, Romania - defended publicly on 27.03.2003. (C. Goiceanu, PhD)

• **Post-graduate Training**

- Summer School “Wave-matter interaction. Microwave measurement Methods and Modeling” organized by INP-Toulouse (Institute National Politechnique de Toulouse), France, April 2001, SOCRATES – ERASMUS Programme. (C. Goiceanu);

- International School of Bioelectromagnetics “Alessandro Chiabrera”, First Course: “Methodology in Bioelectromagnetic Experimental

Investigations” organised by Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, April 21-28, 2004. (C. Goiceanu, PhD).

• **Research Stages**

- Visiting Scientist in IT’IS Laboratories and ETH (Eidgenössische Technische Hochschule – Swiss Federal Institute of Technology) Zurich, Switzerland, June-November 2003 - stage in the field of RF/MW dosimetry in the frame of EUREKA project “SARSYS” (C. Goiceanu, PhD);

- Postdoctoral stage at the University of Bayreuth, Germany, in the frame of DFG (Deutsche Forschungsgemeinschaft) research project “Precision dielectric measurements for the characterization of liquid polymer dynamics at low frequencies”, February - December 2006 (C. Goiceanu, PhD);

During last decade, members of our group joined national and international professional societies:

Romanian Associations:

- Romanian Working Group on Non-ionizing Radiation Protection;

- Romanian Society of Radiological Protection;

- Romanian Society for Pure and Applied Biophysics;

International Associations:

- International Commission on Occupational Health (ICOH);

- International Radiation Protection Agency (IRPA);

- International Union of Radio Sciences (URSI).

ACTIVITIES

During the last 15 years, the IPH Iași was involved in various activities in the domain of health protection

against exposure to EMF. Most of practical activities concerned the determination of EMF exposure at workplaces as well as the investigation of health consequences of occupational exposures. Other type of activities consisted in calculation of exposure limits, drafting Romanian EMF exposure standards and elaboration of measurement methodologies.

Experimental studies of biological exposure to EMF have also been carried out using exposure facilities specially designed and built for this purpose. We briefly present below these activities.

Human studies

Concerning human studies, we have been involved in many complex epidemiological studies concerning RF and MW effects on humans, especially on radar mechanics, as well as in studies concerning the effects of extremely low frequency fields. Our studies are based on clinical, laboratory (biochemistry, hematology, immunology), electrophysiological (computerized EKG, electroneuromyography) investigations, as well as psychological testing.

Measurement of electromagnetic field levels

To characterize EMF exposure, many measurements have been carried out in various workplaces. Generally, spot measurements were employed for both epidemiological studies and for checking compliance of occupational exposure level with the reference level indicated by exposure regulations.

Numerical dosimetry

Having the opportunity of a stage at IT²IS Laboratories from Zurich, Dr. C.

Goiceanu was involved in computing EMF absorption in tissue structures and also in assessing the worst-case absorption in human head tissues when exposed to mobile phone radiation.

Exposure standards

Our work group was deeply involved in the process of developing EMF exposure standards and several drafts of new Romanian EMF standards have been issued. Since 1997, some well prepared and documented standard drafts (mainly based on ICNIRP guidelines) have been proposed to the Ministry of Public Health in order to set up new Romanian protection standards.

Good practices in the measurement of workplaces EMF levels

In order to help good practice in measurement of EMF levels at workplaces, we have thoroughly elaborated a rather complete set of methodologies. Moreover, a “Practical guide for EMF measurement at workplaces” has been written and published in 2006 by the Institute of Public Health Iași.

Exposure experiments

Several microwave exposure experiments were carried out on mice, frogs and vegetal organisms. The animal and the vegetal organisms were exposed to unmodulated low-level microwave field for various periods of time and various numbers of hours per day.

Exposure system

The experimental study of the biological effects of electromagnetic fields requires a well-defined exposure field having the same magnitude for all biological samples. To achieve a

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controlled exposure system, a shielded exposure system of TEM cell type was built, according to the requirements for biological exposure experiments.

Measurement of permittivity of biological tissues

For the study of biological effects of microwaves it is very important to know the dielectric properties of living tissues. Electromagnetic field absorption in tissues and organs is related to the values of tissue permittivity. We measured the permittivity of fresh tissues excised from white rats.

RESEARCH PROJECTS

Internal and National Research Projects:

– “*The assessment of radiofrequencies and microwaves as factors of the work environment in order to assess the occupational risk and to study the health status of some occupationally exposed populations*”, Internal Research Programme, IPH Iasi (Director of Research Project – Dr. R. Dănulescu), 1991-1992;
– “*Epidemiological studies concerning microwave effects on occupationally exposed people*”, Internal Research Programme, IPH Iasi (Director of Research Project – Dr. R. Dănulescu), 1992-1995;
– “*Occupational exposure to video display units connected to computers - impact on health status*”, Internal Research Programme, IPH Iasi (Director of Research Project – Dr. R. Dănulescu), 1994-1998;
– “*Polluting Electromagnetic Field: methods of determination and possible effects on human body*”, grant of the Ministry of Research and Technology,

coordinated by the Institute of Research and Development for Technical Physics Iasi, (Coordinator from IPH Iasi – Dr. R. Dănulescu), 1996-1999;

– “*Measurements on dielectric properties of some biological tissues and liquids in the microwave range*”, Internal Research Programme, IPH Iasi (Director of Research Project – Phys. C. Goiceanu), 1998-1999;
– “*Risk assessment and health impact evaluation in occupational exposure to EMF*”, Internal Research Programme, IPH Iasi (Director of Research Project – Dr. R. Dănulescu MD), 1999-2001;
– “*Evaluation of biological effects of RF fields within controlled exposure experiments on rodents*”, National Program of Community Health PN 1.4., IPH Iasi (Director of Research Project – Phys. C. Goiceanu), 2001-2003;
– “*Studies concerning the possible carcinogenic risk as well as other adverse health effects in occupational exposure to electromagnetic fields*”, National Program of Community Health PN 1.4., IPH Iasi (Director of Research Project – Dr. R. Dănulescu MD), 2003-2007;
– “*Development of methodology for electromagnetic field measurement used in occupational exposure assessment*”, National Program of Community Health PN 1.4, IPH Iasi (Director of Research Project – C. Goiceanu, PhD), 2004-2005;
– “*Studies on bio-electromagnetic interaction and biological impact of human exposure to radiofrequency and microwave electromagnetic fields*”, grant of the Ministry of

Research and Technology, CEEEX Programme, coordinated by Land Forces Academy, Sibiu, (Coordinator from IPH Iasi – C. Goiceanu, PhD), 2006-2007.

– “*Electromagnetic field levels in work environment – Assessment of occupational exposure at specific workplaces*”, National Program of Community Health PN 1.4, IPH Iasi (Directors of Research Project – C. Goiceanu, PhD, Dr. R. Dănulescu MD), 2007-2010.

International Projects:

– “*SARSYS BWP: Development of Procedures for the Assessment of Electromagnetic Exposure from Body-Mounted, Wearable, Portable Wireless Telecommunication Equipment*”, EUREKA project, IT’IS - Information Technology in Society, Swiss Federal Institute of Technology – Zurich (Visiting Scientist – Cristian Goiceanu, PhD), 2003-2005;

– “*Precision dielectric measurements for the characterization of liquid polymer dynamics at low frequencies*”, DFG Project (Deutsche Forschungsgemeinschaft – German Research Foundation), University of Bayreuth (Postdoc – Cristian Goiceanu, PhD), 2006-2007.

– “*Study on the biological effects induced in living bodies by electromagnetic fields; assessing the risk on the environment for the identification of the areas where the pollution fighting or ecological reconstruction are needed*”, grant of Balkan Environmental Association (B.EN.A.), coordinator “Al. I. Cuza”

University of Iasi, (Coordinator from IPH Iași – C. Goiceanu, PhD), 2007.

Participation in EU Coordination / Networking Projects

- EMF-NET Project (ElectroMagnetic Fields NETwork Project) „*Effects of the Exposure to Electromagnetic Fields: From Science to Public Health and Safer Workplace*” (C. Goiceanu, PhD), (<http://www.jrc.cec.eu.int/emf-net/>), 2004 – 2008;

- COST (Cooperation in Science and Technology) action BM0704 : “*Emerging EMF Technologies and Health Risk Management*”, (C. Goiceanu, PhD, Dr. R. Dănulescu, MD, PhD), (http://www.cost.esf.org/index.php?id=212&action_number=BM0704), 2008-2011.

RESULTS

A. Strategies and standards

A complex strategy and programs dealing with health protection against exposure to NIR, in agreement with European policies was developed (4, 5) during the first years of activity of the Group. The project was sustained by Soros foundation and the results of our work was sent at that time to the Ministry of Health in order to improve the Romanian policies concerning the protection against the possible negative effects of nonionizing radiation. During the same first period we have organized, every year, a series of round tables concerning the up-to-date subjects in the field of NIR protection. The next period we focused on the draft proposals for new Romanian protection standards (6), but unfortunately our efforts remained at

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that time only in draft submitted phases. Drafts of EMF exposure standard have been proposed to the Ministry of Health in order to set up new Romanian protection standards. Only later some of our drafts were considered by the factors designated to set up Romanian protection standards. As a result of our work, since 2002 Romanian standards include a large amount of data and concepts presented in our drafts (7).

B. Calculation of new exposure limits

Analyzing many exposure regulations from countries with tradition in this domain, and standards elaborated by international and European organizations, we noticed a lack of provisions in the case of slowly varying magnetic fields. Given the necessity of achieving exposure standards that provide continuity of limits and unambiguous provisions, we calculated additional limits for human exposure to magnetic fields that can be simply added to existing restrictions of present standards. Starting from the exposure limits and reference levels provided by the ICNIRP Guidelines that is the most widely accepted we calculated frequency-dependent ceiling limits for occupational exposure to magnetic fields. This work was published in the official journal of Health Physics Society (8).

C. Exposure assessment

One of our main practical tasks consists in quantifying of occupational EMF exposure and related risk assessment. Many workplaces were investigated, in various domains of

activity and various kinds of sources have been checked out: factories, power plants, power transform facilities and under power lines. We measured many types of electromagnetic fields in a broad frequency range: from static and low-frequency fields to radiofrequency and microwave fields (9, 10). In some cases, where the measured field levels were close to the reference levels or even higher, measures to reduce human exposure have been developed.

The evaluation of EMF exposure also involves dosimetric assessment of electromagnetic energy absorption in tissues, at high frequencies or of induced currents in human body, at low frequencies. Given that experimental dosimetry is an invasive method, practical determination of the above mentioned parameters can be achieved only by numerical dosimetry. During his research stage at IT'IS Laboratories and Swiss Federal Institute of Technology from Zurich, Dr. C. Goiceanu was involved in computing EMF absorption in tissue structures and also in assessing the worst-case absorption in human head tissues when exposed to mobile phone radiation (11).

D. Epidemiological studies

Another main, vast and laborious activity of our team consists in carrying out epidemiological studies on occupationally exposed people to extremely low frequency EMF or to microwaves (12, 13, 14, 15).

Epidemiological and statistical methods appropriate for the study of populations were applied in our work. Electrophysiological investigations like

electroneuromyography, computerized EKG, EEG were applied as well as a wide range of psychological testing, including computerised performance evaluation tests. Various laboratory (biochemistry, hematology, immunology) analysis, using state of the art techniques are also used in our current EMF research activity. The studies on occupationally exposed people to electric and magnetic low-frequency fields, as well as pulsed microwaves showed effects especially on nervous, cardiovascular and immunological systems. Concerning the nervous system, it is seems that an interaction mechanism occurs in which the myelin is primarily damaged and the axon is subsequently injured. Considering the cardio-vascular system, it appears the possibility that ELF fields are involved in the genesis of myocardial excitability and conductivity, as well as in the ischemia pathogenesis. Concerning the immunological status, it is possible that our findings could indicate an early change towards carcinogenesis.

E. Experimental studies on exposure effects

Given that human experimental studies are generally not recommended, the exposure of animals is employed to emphasize possible biological effects of EMF. The studies emphasized changes in mice exploratory activity due to long-term low-level microwave exposure: a decrease in time and a phasic evolution (16, 17). The phasic behavior is related to the presence of two stages of psychomotor activation and inhibition of mice and is probably due to the interference of microwave

with the central nervous system. Another detected effect is related to the changes in oxidative stress markers (18). These changes in the antioxidant status led to some adaptive responses due to the activation of the systems controlling the body oxidative mechanism balance.

F. Exposure facilities

The experimental study of the biological effects of electromagnetic fields requires a well-defined exposure field. Given that the EMF exposure has to be well defined and controlled, a key element in designing biological exposure experiments is the exposure system. We built an exposure system of transverse electromagnetic cell (TEM cell) type. This exposure system allows long-term exposure of animals and vegetal organisms grace to the natural ventilation and illumination inside the system. The large usable volume of the calculated TEM structure (19) allows exposure of a sufficient number of various biological objects: cell cultures, vegetal organisms and small animals up to rat size. The wide band of frequencies that can be coupled to the TEM cell makes it suitable for various types of experiments concerning biological exposure to radiofrequency and microwave fields.

G. Methodologies for exposure evaluation

The problem of measuring environmental electromagnetic field levels is quite sophisticated, especially in some cases (20, 21). Given that this domain is quite new in Romania and many of the operators of EMF measuring equipment

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are not experienced in this field, they need further training and advice. Starting from our personal experience in measuring electromagnetic field levels and studying international literature, we elaborated a general methodology for EMF measurement (22, 23). To ensure the dissemination of information, the Institute of Public Health Iași published a “*Practical guide for EMF measurement at workplaces*” (24) that is meant to be a manual for the personnel involved in this domain. Some steps, methods and procedures are presented in our present work, as well as measurement report models and an algorithm to be used when starting measurements in real cases.

H. Measurement of permittivity of biological tissues

To create a database of dielectric properties of some biological tissues and liquids, we measured the permittivity of fresh excised tissues and liquids from white rats. Many biological tissues were measured: blood, urine, kidney, liver, brain – mixture of white and gray matter, and fat. The measurements were performed in two microwave ranges: S-band ($f = 3$ GHz) by a perturbation method of the resonant cavity and X-band ($f = 10$ GHz) by a differential interferometer method.

I. Cooperation and Communication:

Our group developed complex activities of national and international cooperation. This activity resulted in connections and collaborations with scientists from Romania (Bucharest, Craiova, Cluj, Iasi, Sibiu) and from

other countries (Australia, France, Germany, Hungary, Italy, Japan, Poland, Slovenia, Sweden, Switzerland, United Kingdom) and, also, with international organizations dealing with development of NIR exposure guidelines and risk assessment (ICOH, ICNIRP, IRPA, URSI). Scientists from the Institute of Public Health of Iași also participate in EU Coordination / Networking Projects in the domain of NIRP such as: EMF-NET Project and COST action BM0704.

One of our goals is to provide scientific information and consultancy services for various levels of society: government bodies, local administration, executive staff of enterprises and trade union, general public and media. The risk communication was performed both in the direction of the decision makers and in the direction of providing consultations to the public on biomedical effects of electromagnetic fields. We also elaborated written expert opinions for authorities, economical agents and public.

J. Dissemination of results

The results of our scientific work were disseminated by means of publications and conferences. Some dozens of scientific papers have been published in Romanian and foreign scientific journals. A book has also been published in 2006: “*Practical guide for EMF measurement at workplaces*”. We attended many conferences, congresses and meetings covering various NIRP issues in Romania or abroad. Some of the international

conferences we attended are listed below:

- **IRPA 1996:** 9th International Congress of the International Radiation Protection Association, 14 - 19 April 1996, Vienna, Austria.
- **ICOH 1996:** 25th International Congress on Occupational Health, Stockholm, Sweden, Sept. 15-20, 1996
- **MEDICON 2001:** IX Mediterranean Conference on Medical and Biological Engineering and Computing, 12-15 June 2001, Croatia.
- **URSI 2002:** XXVII General Assembly of the International Union of Radio Science, 17-24 August, Maastricht, Netherlands.
- **EPICOH 2002:** 16th Congress on Epidemiology in Occupational Health, September 11-14 2002 Barcelona, Spain.
- **IRPA 2002:** European Congress of the International Radiation Protection Association, 8-11 October 2002, Florence, Italy.
- **EBEA 2003:** Conference of the European Bio-Electromagnetics Association, 13 - 15 November 2003, Budapest, Hungary.
- **IRPA 2004:** 11th International Congress of the International Radiation Protection Association, 23 - 28 May 2004, Madrid, Spain.
- **EUROEM 2004:** European Electro-Magnetics Conference, 12 - 16 July 2004, Magdeburg, Germany.
- **International Conference “Electromagnetic Fields: from bioeffects to legislation”,** 8 - 9 November 2004, Ljubljana, Slovenia.
- **International Workshop: Electromagnetic Fields at Workplace,** 5-7 September 2005, Warsaw, Poland.

- **IRPA 2007:** Regional Central and East European Congress of the International Radiation Protection Association, 24-28 September 2007, Braşov, Romania.

CONCLUSIONS

In the framework of the Institute of Public Health of Iaşi, many activities concerning health protection related human exposure to non-ionizing radiation have been carried out during last 15 years. Our primary goal is to fight for an active health protection policy by involving in risk assessment, risk management and risk communication related to non-ionizing radiation.

Our group developed practical activities in the domain of non-ionizing protection: determination of electromagnetic field levels at workplaces, quantifying of occupational exposure to electromagnetic fields and related risk assessment, development of measures to reduce occupational exposure. Many workplaces were investigated, in various domains of activity and various kinds of sources have been checked out: factories, power plants, power transform facilities and under power lines.

Given that the domain of non-ionizing radiation protection is new in Romania and much developing at international level, we got involved in drafting exposure standards, calculation of additional exposure limits, elaboration of procedures and methodologies for electromagnetic field measurement. Moreover, a “Practical guide for electromagnetic field measurement at workplaces” was published in 2006 to

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help practitioners to align to good practices in this field.

Scientists from the Institute of Public Health of Iași got involved in many national and international scientific projects on biological and health consequences of electromagnetic exposure. We also participate in EU Coordination and Networking Projects in the domain of health protection against exposure to electromagnetic fields such as EMF-NET Project and COST action BM0704.

Scientific research focused on epidemiological studies on occupationally exposed people to various types of electromagnetic fields. The consequences of exposure to electromagnetic fields were also investigated by means of several controlled experimental studies on animals. To achieve the needed controlled exposure of animals, a specially designed exposure system was built.

The risk communication is also a top priority and its bidirectional dimension, towards decision factors and towards public and media, is a quite challenging and also responsible activity. The public and the authorities seems deeper interested nowadays in the possible and extensively discussed and disputed biological / health effects of electric and magnetic fields. In this direction we will try to find some answers and to inform the stakeholders about the current state of knowledge.

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