

Discussion Paper November 10, 2009

Progressive stages in world-wide knowledge development regarding Electromagnetic Fields & Health Developing conception of associated health effects

Characteristics of a stage in knowledge development

In recent decades important advances have taken place in the development of knowledge worldwide regarding 'electromagnetic fields and health' (EMF&H). These have lent weight to the notion of a range of associated health effects. To make this clearer, the Dutch National Platform on Radiation Risks (NPS) has identified seven distinct stages. These form progressive stages in the development of knowledge related to EMF&H, some of which have been completed, others of which are still underway. Some stages run in parallel with each other; however, taken all together they represent an advance in knowledge. Depending on its place in the development process, each stage has its own characteristic view of the human body, plus associated research methods and assumed mechanisms for the effects of EMFs. These relate to the kinds of expertise available. Organizations often contain within themselves various types of expertise and views and thus will cover more than one stage. From each combination of views, methods and mechanisms, certain types of health effects follow, which are considered possible in that stage. Also, for specific associated disorders, stronger or weaker linkages emerge in relation to EMFs. Together, the seven stages of knowledge development relating to EMF&H form a intriguing series of progressive insights, the end of which is not yet in sight. The whole is progressing towards a state of science which truly reflects reality and is accompanied by recently established organisations and partnerships.

Developments in methods and mechanisms

Thus, in recent decades, increasingly wide-ranging research methods have been used to detect EMF health effects. In conjunction with this, the assumed mechanisms of EMF effects have developed gradually from general, theoretical and physical, to specific, evidence-based and biological. In line with this, where potential EMF-effects are concerned, in recent decades living organisms are less frequently seen as 'irrelevant', black box, heatable tissue or a homogeneous conductive mass. Instead, an increasing number of direct and indirect biological disruptions have been reported that can be caused by heterogeneous electromagnetic fields. Parallel to this, it is becoming clear that a multitude of smaller disruptions may gradually accumulate and carry over into higher levels of biological organisation in the longer term. In addition, alongside traditional reductionistic types of research, a more integrated, multidisciplinary biologically based approach has developed in recent years. Corresponding with this, in the Netherlands and Europe there has been a significant movement towards systems biology research in the last decade, to generate integrated insights into living systems and the processes of disease¹.

¹ The European Research Area ERASysBio Network aims to support the realisation of a European research area in the field of Systems Biological approaches to research. In line with this, the Dutch Organization for Scientific Research (NWO) runs a program 'Research Centres for Systems Biology', as the start of implementation of the theme 'Systems Biology' of the NWO Strategy 2007-2010. An extensive follow-up is planned.

Developments in related health effects & the state of science

The growing insights into research methods and mechanisms of action, have generated progressive knowledge about health effects in successive periods. Thus, around 1950 it was assumed that effects of electromagnetic fields from appliances were limited to technical interference with other devices. In subsequent years after that, there was a growing recognition that these fields could also have acute short-term effects on living organisms. In addition, evidence for long-term effects such as types of cancers, became stronger in the next stage of knowledge development. With predominantly reductionistic research methods, many symptoms were medically not understood, and therefore in the 90's still explained as 'psychosomatic'. During this period there was also steadily increasing understanding of a wide range of biological disruptions that may be caused by heterogeneous electromagnetic fields. From an increasingly multi-disciplinary perspective, mounting scientific evidence has been found that a multitude of such disruptions over time can develop into a wide range of chronic health disorders. In this way, the range of EMF-associated health disorders has continued to expand. In successive stages, this growing list of disorders has been (1) 'no effects', (2) temporary perception of light flashes and disorders in cognitive function, (3) increased risk of cancers and Alzheimer's disease (4) unexplained apparently 'psychosomatic' disorders, (5) stress, neurological and immune related symptoms, (6) chronic fatigue, sleep disorders, immune disorders and nerve pains, and (7) medically unexplained syndromes such as CFS / ME, fibromyalgia, MCS and rheumatism. In addition, the scientific evidence for a link between these chronic diseases and prolonged exposure to a cocktail of electromagnetic fields, has increased in recent decades.

Overview of stages in the development of knowledge

The characteristic elements of each of the stages in the development of knowledge relating to EMF&H are presented below, including progressive evidence for related health effects.

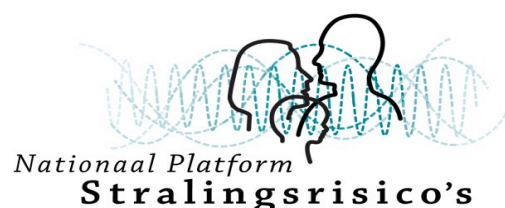
NPS's aim and call for action

With this paper the Dutch National Platform on Radiation Risks aims to improve public awareness of the successive stages of development of knowledge about the domain of EMF&H which have occurred in recent decades. A related aim is to increase understanding of the substantial shifts in perspective that are taking place. Through this continuing development of knowledge, a worsening picture has gradually emerged of long-term adverse health effects from electromagnetic fields and radiation. Exposure to these fields affects the health of many, in the home and elsewhere. In the light of public health, NPS therefore calls for an accelerated shift in world-wide knowledge development in EMF&H, to the promising contemporary stages numbers 5, 6 and 7.

The aim is to improve understanding of the general progress in knowledge development in the last decades, so the dates given and the positioning of organisations are indicative only. NPS is ready as always to discuss these issues further.

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Progressive stages in world-wide knowledge development regarding Electromagnetic Fields & Health Towards a state of science which reflects reality

1. 1950 - 1990

Measuring short-term effects on equipment

experts	traditional source experts, including engineers and physicists
organizations	for example technical organisations as <i>Defense, KEMA, Telecom, IATA, IEEE, IRPA, NVS</i>
view	electrical equipment functioning, human being as (systems) biological black box
mechanism	technical mechanisms of action, such as voltage is current x resistance
methods	measurement and calculation of technical interference and disturbances
type of h effect	not considered applicable, only technical interference or equipment failure
examples	no health effects, only different malfunctions of technical equipment
question	also possible influences on electro-physiological processes of living organisms?

2. 1960 - 2000

Calculating short-term effects on health

experts	traditional source experts and health experts, including engineers, physicists and physicians
organizations	for example <i>KEMA, Telecom, IATA, IEEE, IRPA, NVS, ICNIRP, TNO, WHO, GR, SCENIHR, RIVM</i>
view	man as a conductive sphere and heat-sensitive tissue; systems- and molecular-biological black box
mechanism	general physical interaction with tissues, such as heating or electrical stimulation
methods	theoretical derivation and model-based calculation of (AC) current densities and heating
type of h effect	limited short-term effects are considered possible at strong (AC) currents, also warming
examples	(plus)* perceiving of light flashes (magnetofosfenen) and temporary changes in cognitive functions
question	to what extend are theory and calculation of evoked physical changes related to reality?

3. 1990 to 20 ..

Statistical examination of long-term effects on health

experts	source and health effect experts, including physicians, epidemiologists and psychologists
organizations	for example <i>WHO, GR, SCENIHR, NIVEL, RIVM, RNCNIRP, K-platform EMF, ZonMw, SHC</i>
view	man as medical-physical phenomenon; system- and molecular-biological black box
mechanism	general physical interaction with tissues (eg heating), plus medically unexplained mechanisms
methods	reductionistic research: epidemiological assessment of statistical evidence at high exposure
type of h effect	evidence for some of long-term health effects
examples	(plus)* increased risk of childhood leukaemia, breast and brain tumours and Alzheimer's disease
question	enough detection power for chronic low exposure, complex exposure and when minor differences?

* Each set of examples is in addition to the examples cited in the previous stages

4. 1995 to 20 ..

Psychological explanation for not understood long-term effects

expert	health experts, including physicians, epidemiologists, psychologists, sociologists
organizations	for example <i>WHO, GR, NIVEL, RIVM, GGD'en, Knowledge Platform EMF, ZonMw</i>
view	man as psychosomatic being; systems- and molecular-biological black box
mechanism	risk perception, psychosomatic mechanism, nocebo effect, symptom attribution, somatisation
methods	indicate residual diagnosis, because occurring health problems appear not related to exposure
type of h effect	long-term health effects are considered possible, based on psychosocial mechanisms
examples	(plus)* not comprehended syndromes, as functional somatic syndrome, 'psychosomatic' symptoms
question	is complex dose size sufficiently understood? can short-term studies actually say something?

5. 2000 to 20 ..

Approaches to long-term health effects from bio-disruptions

experts	health effect and bioprocess experts, including multidisciplinary biomedici, biologists, biophysicists
organizations	for example <i>BioInitiative Group, Ecolog Institute, RNCNIRP, SHC, ICEMS, ZonMw, NPS, EEA</i>
view	human being as a bio-medical phenomenon; set of organ systems and biological processes
mechanism	(electro)physiological disruptions carrying across into different higher subsystems of organisms
methods	global clustering of multiple data fragments from research, for each subsystem
type of h effect	clusters of long-term health effects are possible in various organ systems
examples	(plus)* evidence for stress response, effects on genes, immune function, neurology and behaviour
question	to what extent is a coherent and integrated systems-biological insight gained?

6. 2002 to 20 ..

Revelation of health effects from medical practices

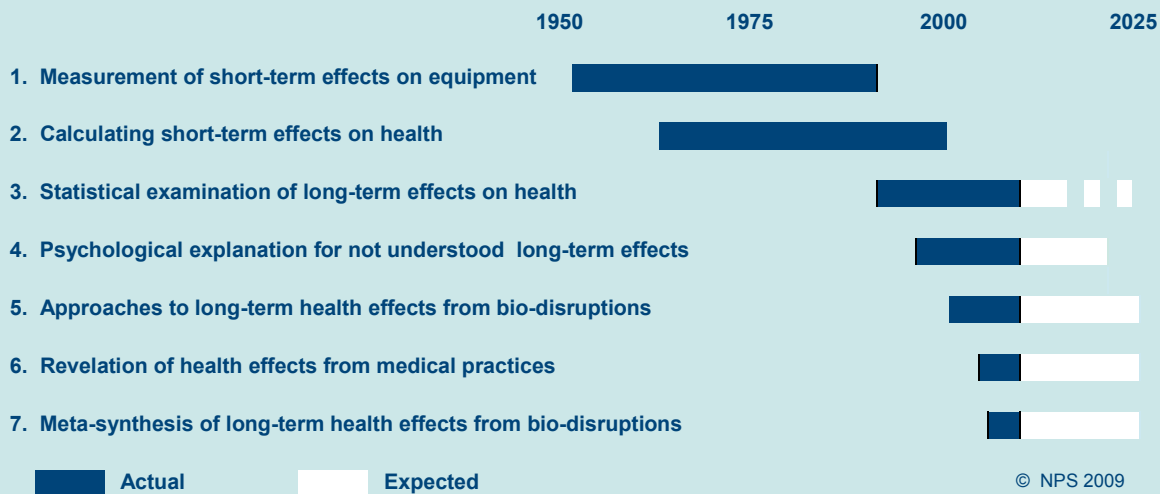
experts	health experts, including doctors and paramedics
organizations	f.i. <i>Freiburg Appeal, Bamberg Appeal, Helsinki Appeal, Dutch Appeal, GGD'en, EEA</i>
view	man as chemical-mechanical whole; systems- and molecular-biological black box
mechanism	combination of physical interaction plus unknown mechanisms: source gone - complaints gone
methods	evaluation of symptoms that doctors and patients relate to EMF sources
type of h effect	indications for general non-specific health symptoms
examples	(plus)* chronic fatigue, headaches, sleep and immune disorders, nerve pains, etc.
question	does current thermal limit protect against an accumulation of biological disruptions?

7. 2005 to 20 ..

Meta-synthesis of long-term health effects from bio - effects

experts	multilevel bioprocess experts, including multi-disciplinary biomedici, biophysicists, system biologists
organizations	for example <i>BioInitiative Group, ICEMS, EraSysbio, WUR, NPS, EEA</i>
view	man as a complex set of (electro)physiological interactions between biological subsystems
mechanism	accumulation and intrinsic enhancing of range of bio-disruptions at various levels of organization
methods	systems-biological integration of a wide variety of reported biological disruptions
type of h effect	range of health effects resulting from heterogeneous accumulation of bio-disruptions
examples	(plus)* evidence for contribution to overlapping syndromes such as CFS/ME, MCS and rheumatism
question	how can a multitude of reported biological disruptions be integrated optimally?

Progressive stages in world-wide knowledge development regarding EMF & Health



Abbreviations

BioInitiative Group

International group of scientists and professionals in public health that compiled a biology based 'BioInitiative Report on EMF & Health'

Defense

Ministry of Defense

Ecolog Institute

Institute for Social and Ecological research and building - Hannover Germany

EEA

European Environment Agency - Denmark

EMF

Electromagnetic Fields, both high and low frequency

GGD'en

Municipal Health Services

GR

Health Council - Netherlands

IATA

International Air Transport Association

ICEMS

International Commission for Electromagnetic Safety

ICES

International Committee on Electromagnetic Safety, part of IEEE

ICNIRP

International Commission on Non-Ionizing Radiation Protection

IEEE

Institute of Electrical and Electronics Engineers

IRPA

International Radiation Protection Association; appoints ICNIRP-members

KT

Short term

LT

Long term

KEMA

Worldwide company for advice, quality assurance and product certification of Electrical equipment and networks

Knowledge Platf EMF

Dutch Platform on EMF - of RIVM, TNO, KEMA, GGD'en, Telecom Agency, and ZonMw - that makes science around electromagnetic fields intelligible

NIVEL

Dutch Institute for Health Services Research

NPS

National Platform on Radiation Risks - Netherlands

NVS

National Health Physics Association; member of IRPA

RNCNIRP

Russian National Committee on Non-Ionizing Radiation Protection

RIVM

National Institute for Public Health and the Environment – Netherlands

SCENIHR

Scientific Committee on Emerging and Newly Identified Health Risks (part of EC/DGHC)

SHC

Superior Health Council - Belgium

Telecom

Specialist in sales and distribution of mobile telephones, subscriptions and mobile accessories

TNO

Organization for Applied Scientific Research

WHO

World Health Organization

WUR

Wageningen University and Research

ZonMw

Dutch organization for health research and development