

2020 GLORE meeting
Ottawa, Canada



Update on the WHO Systematic Reviews on RF-EMF

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The World Health Organization

- Established on **7 April 1948**
- **Function:** act as the UN directing and coordinating authority on international health work
- **Objective:** attainment by all peoples of the highest possible level of health



The WHO 3-level structure

- 7000 people work for WHO in
- 150 WHO offices in countries, territories and areas,
- 6 regional offices,
- at IARC, and
- at the headquarters (Geneva)



PEOPLE

Last but not least, WHO is people. Over 8000 public health experts including doctors, epidemiologists, scientists, managers, administrators and other professionals from all over the world work for WHO in 147 country offices, six regional offices and at the headquarters in Geneva, Switzerland.

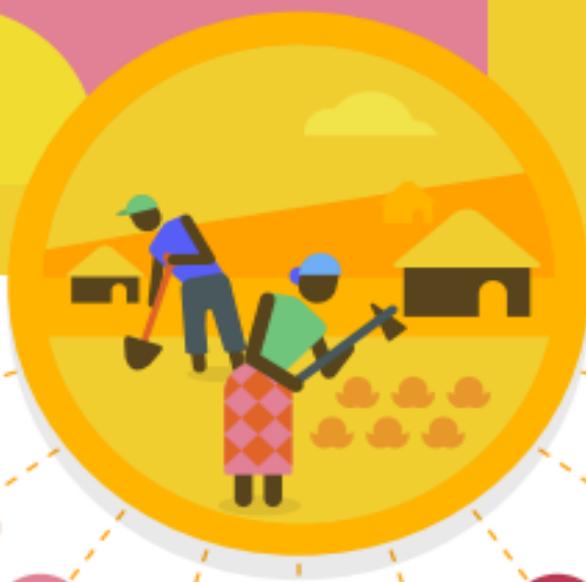


WHO's core functions

1. Articulate ethical and evidence-based **policy positions**
2. Setting **norms and standards**, and promoting and monitoring their implementation
3. Shaping the **research agenda**, and stimulating the generation, translation and dissemination of valuable knowledge
4. Providing **technical support**, catalysing change and developing sustainable institutional capacity
5. **Monitoring** the health situation and assessing health trends
6. Providing **leadership** on matters critical to health and engaging in **partnerships** where joint action is needed

HOW THE ENVIRONMENT IMPACTS OUR HEALTH

People are exposed to risk factors in their homes, work places and communities through:



AIR POLLUTION

Including indoors and outdoors



INADEQUATE WATER, SANITATION and hygiene



CHEMICALS and biological agents



RADIATION

ultraviolet and ionizing



COMMUNITY NOISE



OCCUPATIONAL RISKS



CLIMATE CHANGE



BUILT ENVIRONMENTS

Including housing and roads



AGRICULTURAL PRACTICES

Including pesticide-use, waste-water reuse



POWER LINES



RADAR



TRAINS



0 Hz 10^2 10^4 10^6 10^8 10^{10} 10^{12}

FREQUENCY (Hz OR CYCLES PER SECOND)



PERSONAL COMPUTER

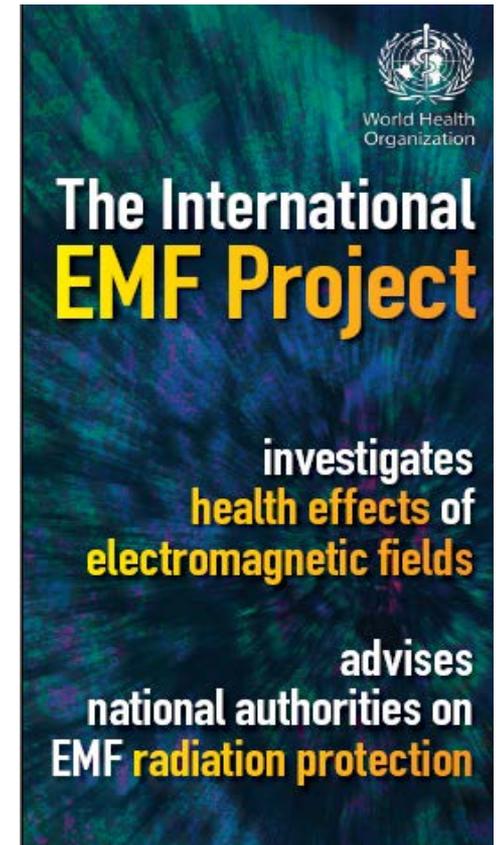


CELL PHONE

WHO International EMF Project



- **Established in 1996**
- **Coordinated by WHO HQ**
- **A multinational, multidisciplinary effort to create and disseminate information on human health risk from EMF**
- **Membership**
 - Open to any WHO Member State government department or representatives of national institutions concerned with radiation protection
 - Over 60 national authorities have been involved in the Project



Applications using radiofrequency fields (100 kHz – 300 GHz)



Telecommunications



Navigation/Radar



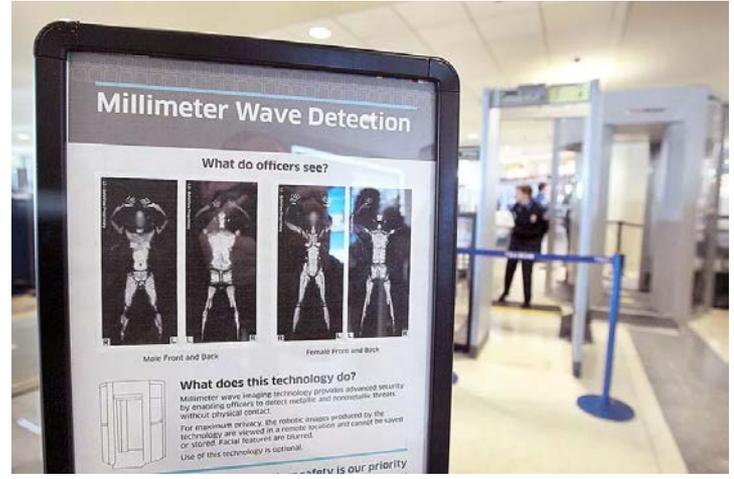
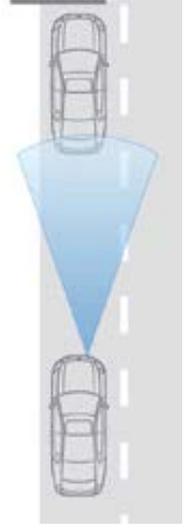
Commercial



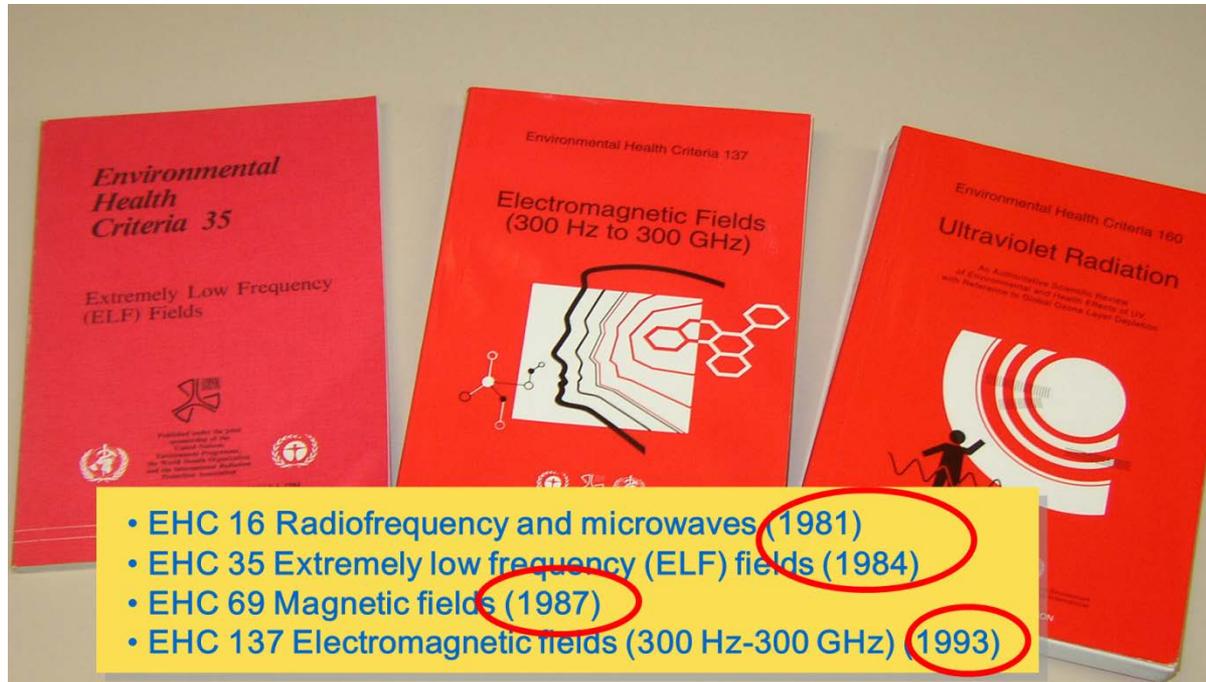
Broadcasting



Residential sources

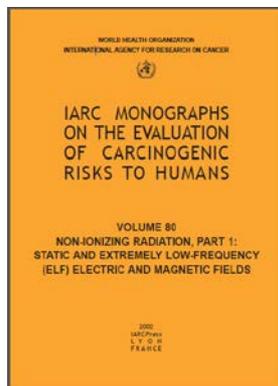


WHO Monographs on Electromagnetic fields



- EHC 16 Radiofrequency and microwaves (1981)
- EHC 35 Extremely low frequency (ELF) fields (1984)
- EHC 69 Magnetic fields (1987)
- EHC 137 Electromagnetic fields (300 Hz-300 GHz) (1993)

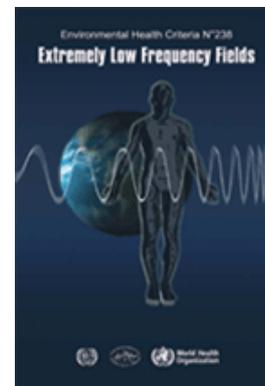
Health risk assessments



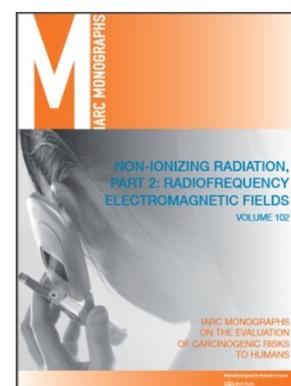
2002



2006



2007



2013



RF Fields

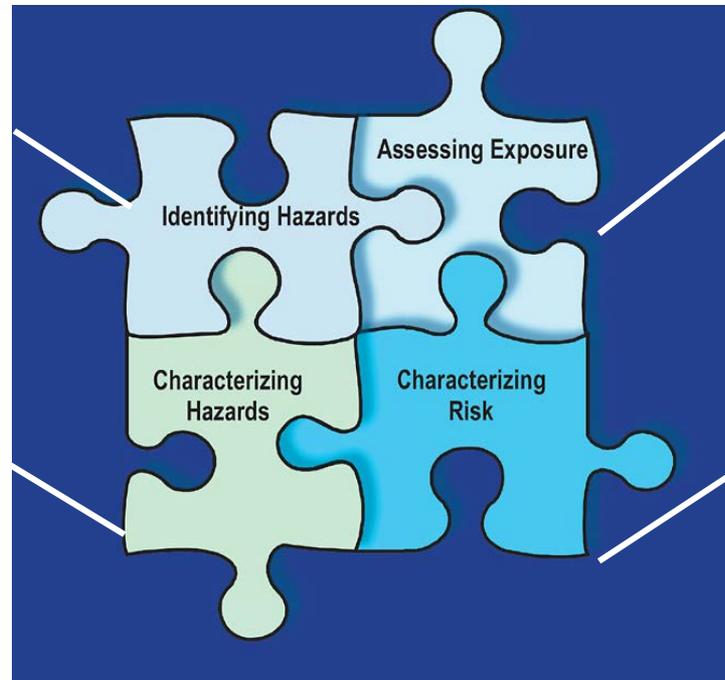
Health Risk Assessment

1. Hazard identification

What is the agent and what health problems can it potentially caused?

3. Dose-response relationship

What are the health problems at different exposure levels?



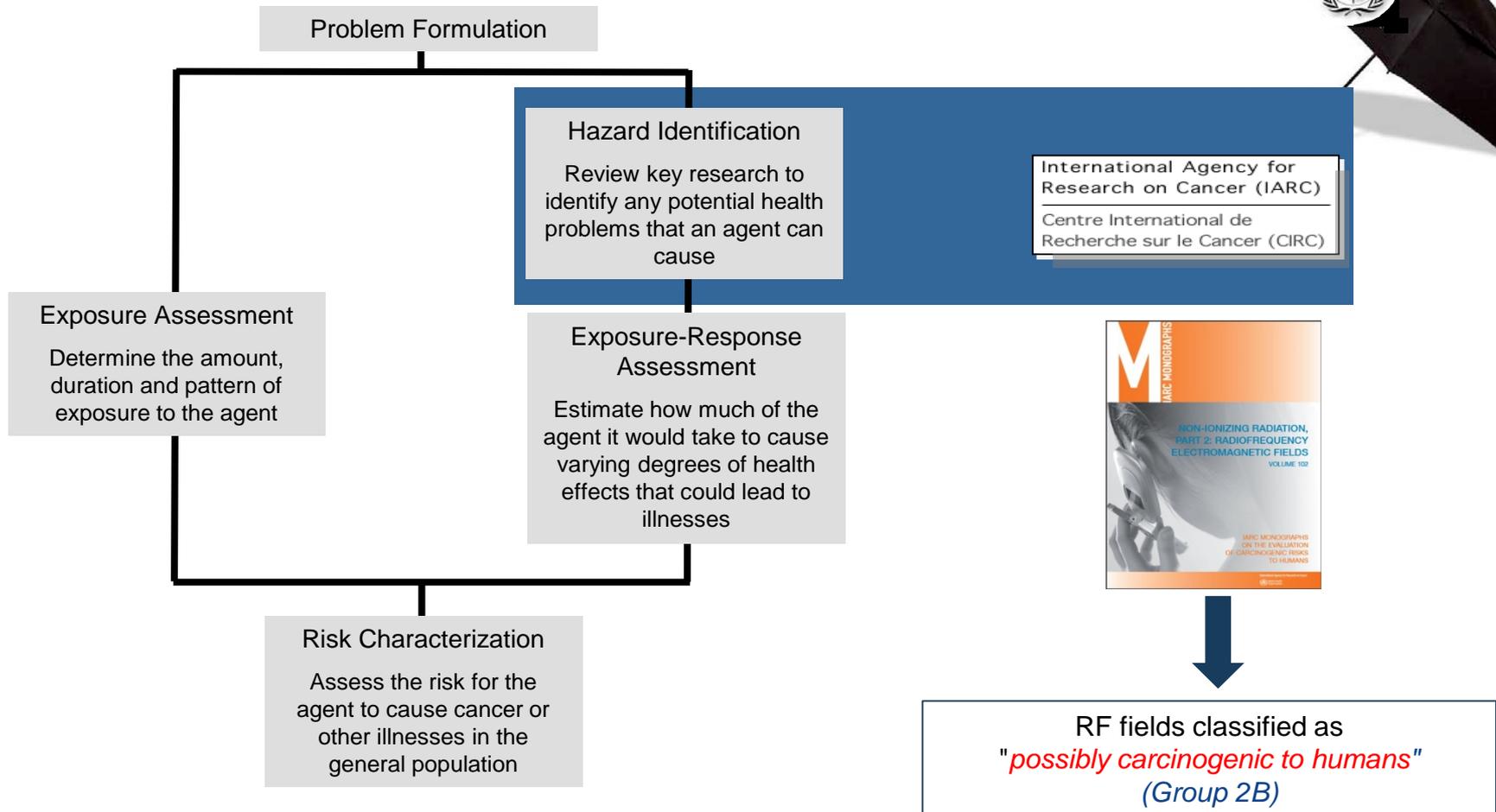
2. Exposure assessment

What exposures are likely to occur, and what is the resulting dose to humans?

4. Risk characterization

What is the health risk in the exposed population?

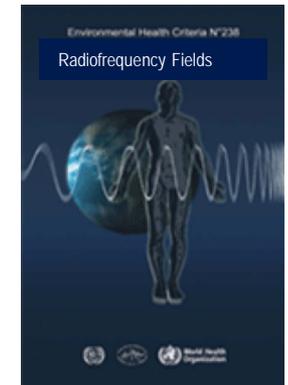
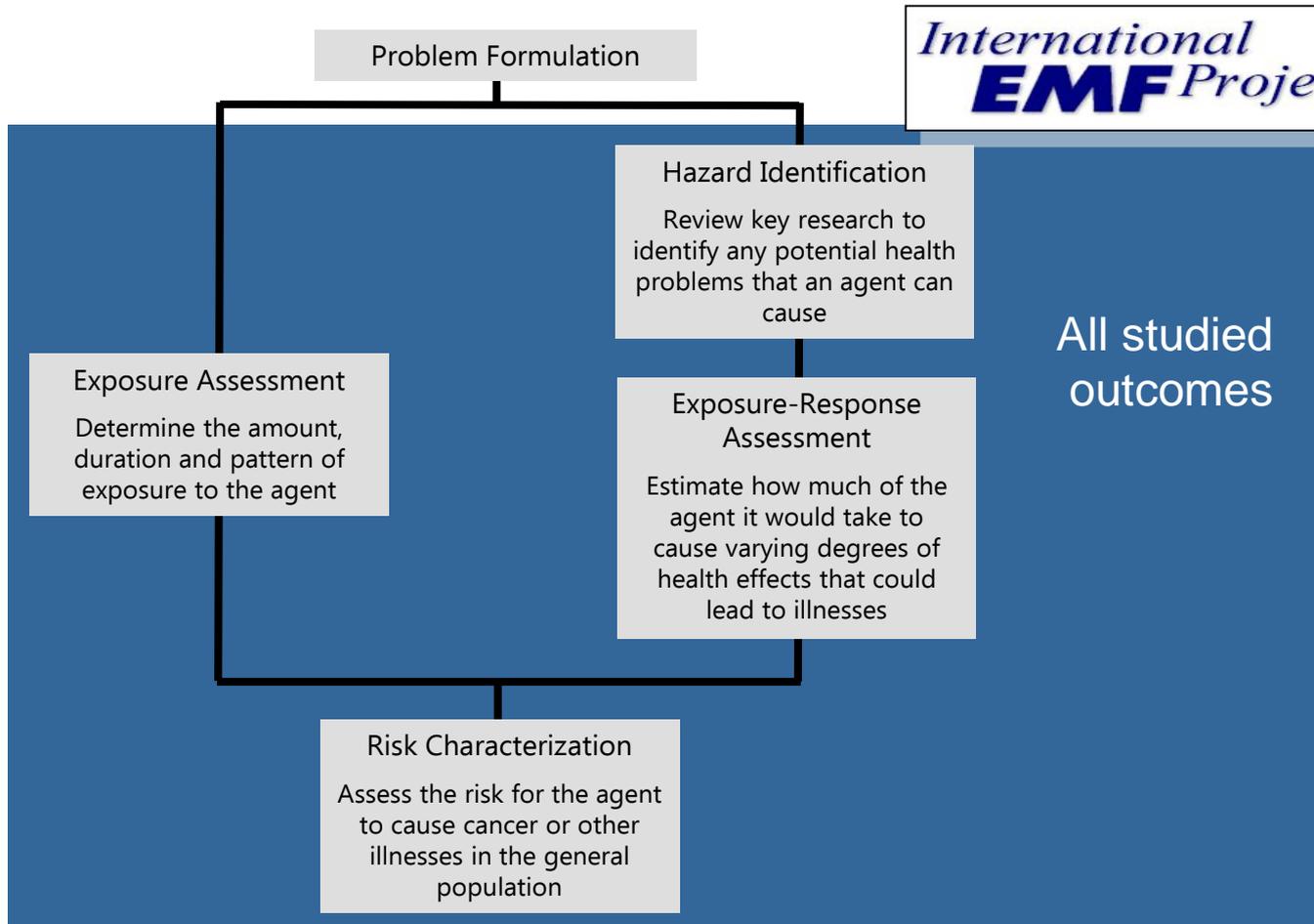
Health Risk Assessment



Health Risk Assessment (cont'd)



International
EMF Project



Narrative review (2012-17)

- Kickoff meeting of a Core Group of experts (2012)
- International survey of radiofrequency policies (2012)
- International stakeholders meeting (2013)
- Online first draft for comments (Fall 2014) – over 700 comments
- Incorporation of comments (2015)
- WHO request for systematic review process (2016)
 - *“although the types of questions that are being examined and the statements that will be issued are not typical ones related to interventions, they will have global impact and must be based on a systematic review of the evidence and transparent, explicit processes that minimize bias. Thus the basic principles for guideline development apply”.*
 - Enlisted help of a contracted methodologist
- Update of draft with latest publications (2017-present)

International survey of priority outcomes (2018)



WHO will commission a number of systematic reviews to analyze and synthesize the available evidence on the most important potential adverse health outcomes. Appropriate selection of these health outcomes is therefore key to producing a useful monograph, **considering available resources and timeline of the project.**

To prioritize health outcomes, WHO sought the opinion of experts on the topic of radiofrequency electromagnetic field exposures and health to complete an **online survey titled "Rating Potential Adverse Health Outcomes of Exposure to Radiofrequency Fields"** to help prioritize the health outcomes to be addressed systematically. Over 300 RF experts were invited, and 167 responses received.

Rating Potential Adverse Health Outcomes
of Exposure to Radiofrequency Fields

Survey Preliminary Results – Descriptive
Statistics

Note: Results are representative of completed survey responses collected up until June 28 2018

International survey of priority outcomes (cont'd)

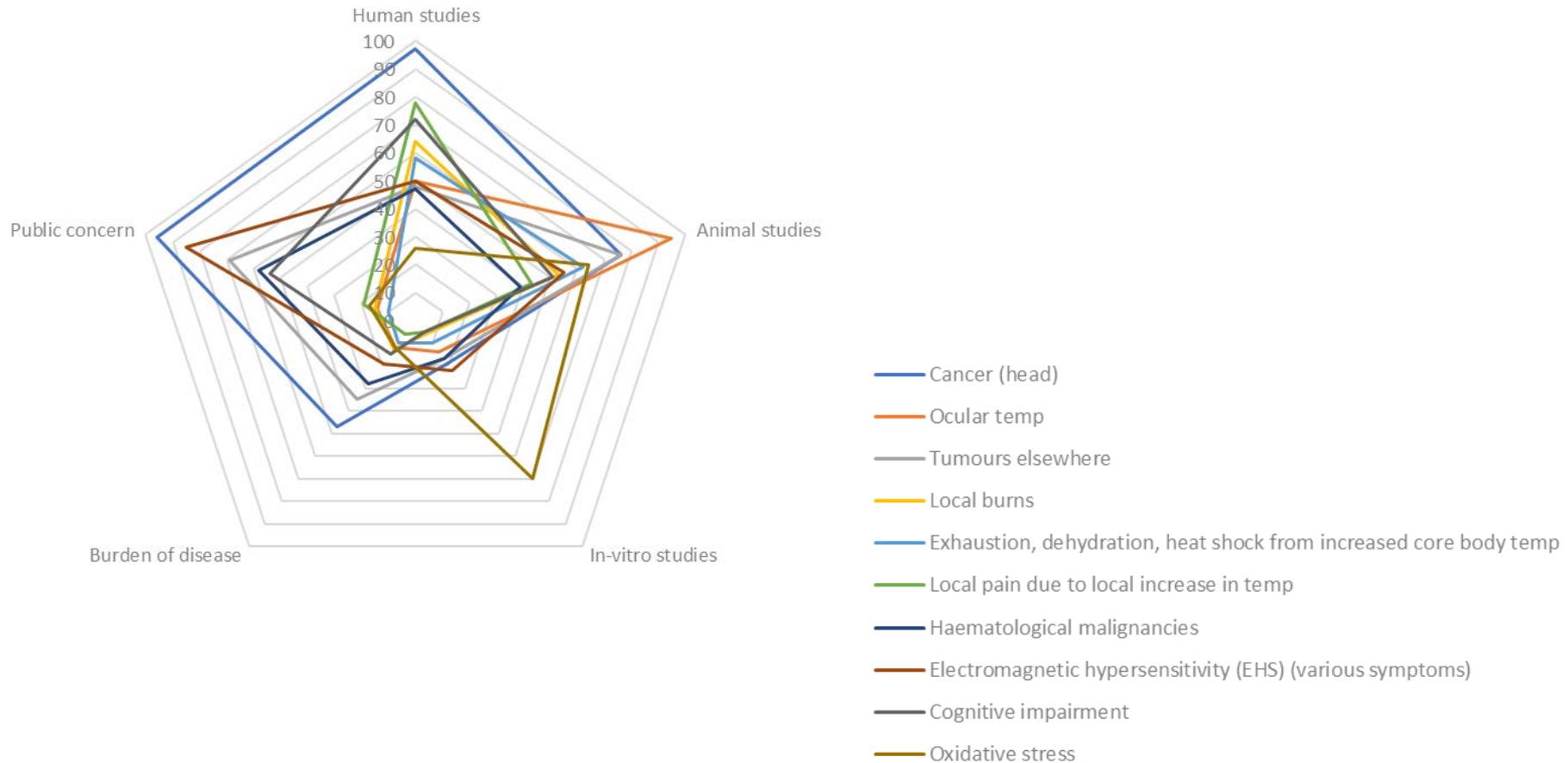


■ Unimportant ■ Important ■ Critical



Priority outcomes

Rationale



Call for Expression of Interest (2019)

The World Health Organization's (WHO) Radiation Programme has an ongoing project to assess potential health effects of exposure to radiofrequency electromagnetic fields in the general and working population. To prioritize potential diverse health outcomes, WHO conducted a broad [international survey](#) in 2018. Ten major topics were identified for which WHO will now commission systematic reviews to analyze and synthesize the available evidence.

Through this Call, WHO invites eligible teams to indicate their interest in undertaking a systematic review on one (or more) of the following topics:

↓ [SR1 – Cancer \(human observational studies\)](#)
⇒ pdf, 525kb

↓ [SR2 – Cancer \(animal studies\)](#)
⇒ pdf, 628kb

↓ [SR3 – Adverse reproductive outcomes \(human observational studies\)](#)
⇒ pdf, 634kb

↓ [SR4 – Adverse reproductive outcomes \(animal and in vitro studies\)](#)
⇒ pdf, 633kb

↓ [SR5 – Cognitive impairment \(human observational studies\)](#)
⇒ pdf, 633kb

↓ [SR6 – Cognitive impairment \(human experimental studies\)](#)
⇒ pdf, 633kb

↓ [SR7 – Symptoms \(human observational studies\)](#)
⇒ pdf, 631kb

↓ [SR8 – Symptoms \(human experimental studies\)](#)
⇒ pdf, 631kb

↓ [SR9 – Effect of exposure to RF on biomarkers of oxidative stress](#)
⇒ pdf, 628kb

↓ [SR10 – Effect of exposure to heat from any source on pain, burns, cataract and heat-related illnesses](#)
⇒ pdf, 526kb

Expressions of interest



Call for expression of interest

SR-6. Systematic reviews of exposure to radiofrequency fields and cognitive impairment (human experimental studies)

The World Health Organization's (WHO) Radiation Programme in the Department of Public Health, Environmental and Social Determinants of Health (Geneva, Switzerland) has an ongoing project to assess potential health effects of exposure to radiofrequency electromagnetic fields in the general and working population. To prioritize potential adverse health outcomes, WHO conducted a broad international survey in 2018. Ten major topics were identified for which WHO will now commission systematic reviews to analyze and synthesize the available evidence.

Through this Call, WHO invites eligible teams to indicate their interest in undertaking a systematic review on radiofrequency fields and cognitive impairment (human experimental studies).

Participating review teams will receive ongoing methodological guidance from WHO Secretariat. The team's contribution of a systematic review will be acknowledged in the official WHO publication on radiofrequency fields. The systematic reviews will be submitted for open-access international peer-reviewed publication(s).

Scope of the research

The review team should conduct a systematic review on the topic of exposure to radiofrequency fields and cognitive impairment for the following PECO¹ question:

- Effect of exposure to radiofrequency fields (E) on cognitive impairment (O) compared to no/low level of exposure (C) in volunteers (P) in human experimental studies

Systematic review approach

The systematic reviews should be conducted according to the quality requirements for systematic reviews as formulated in the [WHO Handbook of Guideline Development](#) and should be reported according to the [PRISMA standard](#). WHO will provide review teams with a detailed draft protocol stating the PECO questions and methods for conducting the systematic review based on state-of-the-art methods. The systematic review teams will be asked to finalize the protocols and to register them in the [PROSPERO](#) database. The systematic reviews will then be conducted according to the lines set out in the protocols. The final deliverables are systematic reviews in scientific article format. A small contribution towards the operating costs for the conduct of the systematic review will be available.

Requirements and process

The systematic review team will be selected from the submitted expressions of interest and based on the members' qualifications and skills (see specifications below). The team should be composed

¹ PECO is an acronym for the four elements that should be considered in any question governing a systematic search of the evidence: (P) population, (E) exposure, (C) comparator and (O) health outcome.

of at least two members to enable study selection, data extraction and risk of bias analysis in duplicate. Geographical diversity is encouraged.

The systematic review team leader must provide information regarding the composition of the team (proposed team members, their organizational affiliations and their relevant expertise and skills), description of similar assignments, examples of relevant reports or publications using the enclosed *curriculum vitae* for each team member. The team members will participate in their individual capacity rather than a representative of their employer. Each member will also need to complete the standard [WHO Declaration of Interest form](#), which will be assessed for conflict of interests.

Expressions of interest must be delivered electronically to the WHO Secretariat at emfproject@who.int with subject line: "Expression of interest for SRT-6" no later than 16:00 (CET) on 4 November 2019.

The team leader may be asked to further elaborate the expression of interest in a video meeting with the WHO Secretariat. The final candidates will be selected through a competitive process in accordance with WHO's policies and procedures.

Expected deliverables and timelines

The systematic review should be completed within a 12-month timeframe. It is anticipated that the systematic review will begin as soon as practicable, but no later than 2 December 2019.

1. Final version of protocol and registration in Prospero (+ 1 month from start)
2. Operational search strategies for all relevant databases as listed in the protocol (+ 1 month)
3. Risk of bias assessment tool(s) developed, including aspects related to exposure assessment (+ 1 month)
4. List of references to be checked as full-text studies (+ 1 month)
5. List of included and excluded studies (+ 1 month)
6. Tables on (i) characteristics of included studies, (ii) effects of exposure to radiofrequency radiation on the outcome, and (iii) risk of bias in included studies (+ 3 months)
7. Draft manuscript ready for peer review (+ 1 month)
8. Final manuscript for journal submission (+ 1 month after receipt of comments)

Qualifications and skills required

The successful teams would have to fulfil the following criteria:

- Expertise in cognitive impairment;
- Expertise in human experimental studies;
- Expertise in RF dosimetry;
- Demonstrated experience in conducting systematic reviews in environmental health;
- Experience in scientific writing and communications on environmental health and/or experimental studies;
- Strong communication skills in English, both written and oral.

Expressions of interest (cont'd)

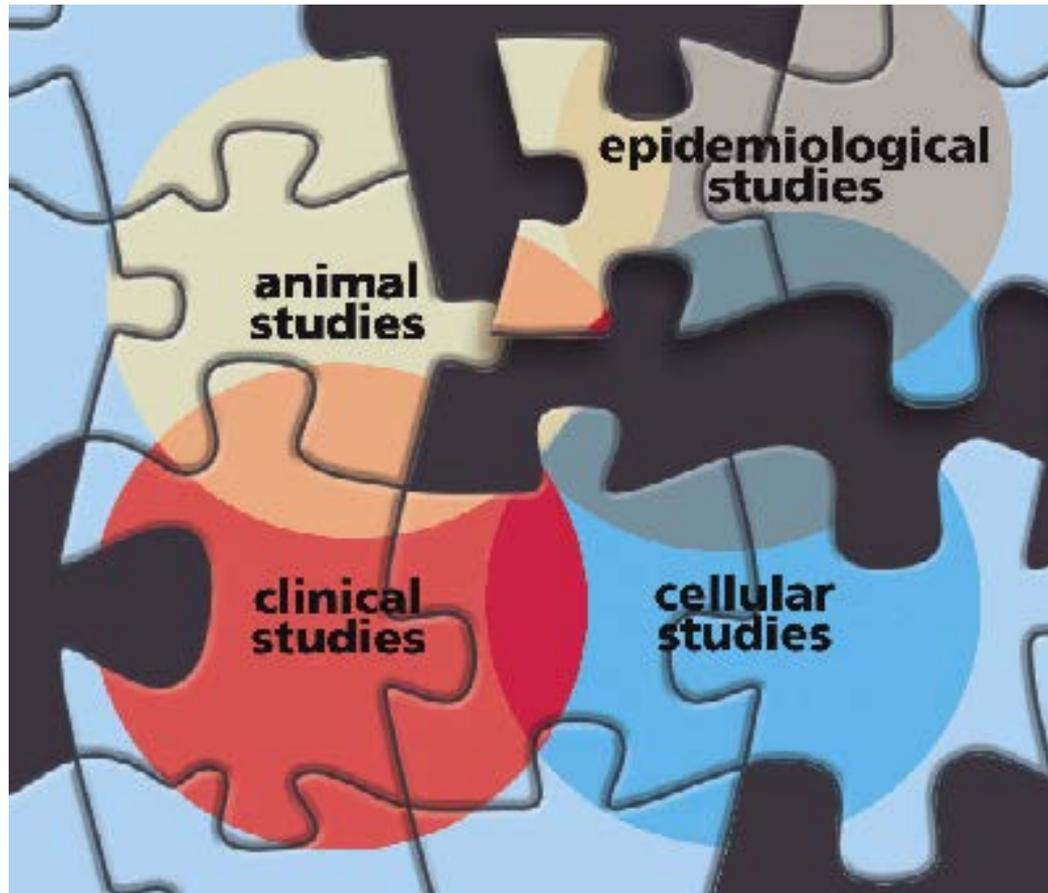
Systematic review topic	Number of applications
Cancer (observational studies)	9
Cancer (experimental studies)	3 / 2
Adverse reproductive outcomes (observational studies)	4
Adverse reproductive outcomes (experimental studies)	2 / 2
Cognitive impairment (observational studies)	3
Cognitive impairment (experimental studies)	3
Symptoms (observational studies)	3
Symptoms (experimental studies)	3
Oxidative stress	4
Heating	0 / 2

Expertise

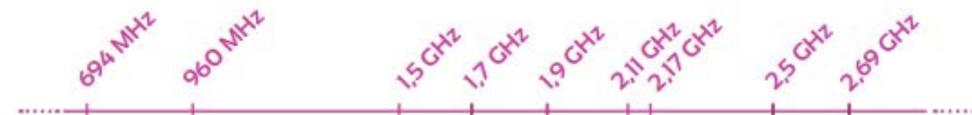


Evaluating the health risks

Review of research



<http://www.niehs.nih.gov/emfrapid/booklet/emf2002.pdf>



Systematic reviews

Epidemiological studies



SR1 - Cancer

- *Effect of exposure to radiofrequency fields from mobile phone use (E) on cancer in the head region, i.e. brain tumours (glioma, meningioma, acoustic neuroma), salivary gland tumours, and pituitary gland tumours (O) compared to no/low exposure (C) in the general population (P)*
- *Effect of exposure to radiofrequency fields from environmental sources (radio- and television transmitters and base stations) (E) on cancer (O) compared to no/low exposure (C) in the general population (P)*
- *Effect of exposure to radiofrequency fields (E) on cancer (O) compared to no/low exposure (C) in workers (P)*

Adverse reproductive outcomes

- *Effect of exposure to radiofrequency fields (E) on fertility (O) compared to no/low exposure (C) in the male population (P)*
- *Effect of exposure to radiofrequency fields (E) on pregnancy and birth outcomes (O) compared to no/low exposure (C) in the female population (P)*

Cognitive impairment

- *Effect of exposure to radiofrequency fields (E) on cognitive impairment (O) compared to no/low level of exposure (C) in the general population (P) in human observational studies*

Symptoms

- *Effect of exposure to radiofrequency fields (E) on symptoms (O) compared to no/low level of exposure (C) in the general population and electromagnetic hypersensitive individuals (P) in human observational studies*

Systematic reviews

Experimental studies



Human volunteer studies	Animal studies	In-vitro studies
<p>SR6 (cognitive impairment)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on cognitive impairment (O) compared to no/low level of exposure (C) in volunteers (P) in human experimental studies 	<p>SR2 (cancer)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on cancer (O) compared to sham exposure (C) in animals (P) in experimental studies 	<p>SR4 (adverse reproductive outcomes)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on male fertility (O) compared to sham exposure (C) in using in-vitro human semen (P)
<p>SR8 (symptoms)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on symptoms (O) compared to no/low level of exposure (C) in individuals (adults and children) reporting symptoms from exposure to EMF (P) in human experimental studies Effect of exposure to radiofrequency fields (E) on perception (O) compared to no/low level of exposure (C) in individuals reporting symptoms from exposure to EMF, and individuals reporting not getting symptoms from exposure to EMF (P) in human experimental studies 	<p>SR4 (adverse reproductive outcomes)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on male fertility (O) compared to sham exposure (C) in experimental animals (P) Effect of exposure to radiofrequency fields (E) on adverse pregnancy and birth outcomes (O) compared to sham exposure (C) in experimental animals (P) 	<p>SR9 (oxidative stress)</p> <ul style="list-style-type: none"> Effect of exposure to radiofrequency fields (E) on the most important and best validated biomarkers for oxidative stress (O) compared to no/lower exposure (C) in animals, humans or cells (P).
	<p>SR9 (oxidative stress)</p> <ul style="list-style-type: none"> Effect of exposure to RF EMF (E) on the most important and best validated biomarkers for oxidative stress (O) compared to no/lower exposure (C) in animals, humans or cells (P). 	

Deliverables



- Registration of the protocol in Prospero, or another appropriate protocol database
- Submission of the protocol to *Environment International*
- Submission of the systematic review to *Environment International*

Special issue on RF systematic reviews

Environment International

Peer-reviewed journal



Environment International is a peer-reviewed scientific journal covering environmental science and health. It was established in 1978 and is published eight times per year by Elsevier. The co-editors-in-chief are Adrian Covaci, Mark Nieuwenhuijsen, Zhen He, and Yongguan Zhu. [Wikipedia](#)

Impact factor: 7.943 (2018)

History: 1978-present

ISO 4: Environ. Int

LCCN: 81649513

People also search for: [Environmental Research](#), [MORE](#)

Editors: [Adrian Covaci](#), [Mark Nieuwenhuijsen](#), [Zhen \(Jason\) He](#), [Zhu Yongguan](#)

Disciplines: [Environmental science](#), [Environmental health](#)



Environment International 143 (2020) 105926



ELSEVIER

Contents lists available at [ScienceDirect](#)

Environment International

journal homepage: www.elsevier.com/locate/envint



Recommendations for the conduct of systematic reviews in toxicology and environmental health research (COSTER)

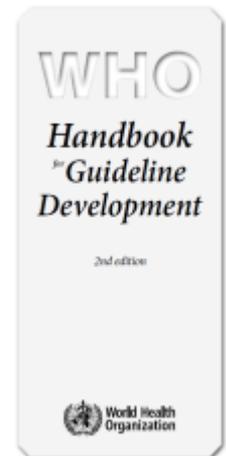
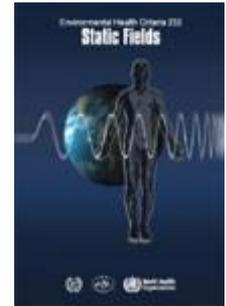


Paul Whaley^{a,*}, Elisa Aiassa^b, Claire Beausoleil^c, Anna Beronius^d, Gary Bilotta^e, Alan Boobis^f, Rob de Vries^g, Annika Hanberg^h, Sebastian Hoffmannⁱ, Neil Hunt^j, Carol F. Kwiatkowski^k, Juleen Lam^l, Steven Lipworth^m, Olwenn Martinⁿ, Nicola Randall^o, Lorenz Rhomberg^p, Andrew A. Rooney^q, Holger J. Schünemann^r, Daniele Wikoff^s, Taylor Wolffe^t, Crispin Halsall^u

Radiofrequency Fields Publications

Appraisal of the evidence for health risks associated with exposure to RF fields to result in several publications.

- A technical report as a scoping review of the **scientific literature of studied health outcomes**.
- A series of **systematic reviews** on priority health outcomes to be published in a special issue of *Environment International*
- The **RF EHC monograph** will elaborate on the health outcomes highlighted in the review process, using procedures for guideline development as recently required by WHO
- An RF **Research Agenda**



Challenges and next steps

Challenges

- Funding
- Limited expertise of EMF researchers in performing systematic reviews
- COVID-19 (meetings)

Next steps

- Currently, attempt to harmonize risk-of-bias assessment and GRADE
- Finalize protocols and publish them
- Finalize the narrative review
- Set up a **Task Group** will be tasked with finalizing conclusions on all health outcomes reviewed, as well as developing research recommendations, and a health risk assessment.
- The **Task Chair** has been appointed



SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

