

# HOW PROBABLE ARE HEALTH EFFECTS OF RADIATION FROM WIRELESS TRANSMITTING DEVICES?

Dariusz Leszczynski, PhD, DSc

Adjunct Professor of Biochemistry, *University of Helsinki, Finland*

Editor-in-Chief of *Frontiers in Radiation and Health, Switzerland*

Science blogger @ BRHP – *Between a Rock and a Hard Place*

# WHO I AM... EDUCATION AND WORK

- Two doctorates and docentship in biochemistry
- Independent expert; actively advising and lecturing
- 22 years (1992-2013) at STUK
  - 2003-2007 as Head of Radiation Biology Laboratory
  - 2000-2013 as Research Professor
- Assistant Professor at Harvard Medical School, USA; 1997-1999
- Guangbiao Prof. at Zhejiang Univ., Hangzhou, China; 2006-2009
- Visiting Prof. at Swinburne Univ. Technology, Melbourne, Australia; 2012-2013

# WHO I AM... EXPERT EXPERIENCE

- 20 years of experimental work on EMF and health
- Testified
  - In the Canadian Parliament's House of Commons' hearing in 2015
  - before Minister of Health and Family Welfare of India in 2014
  - In the US Senate Appropriations Committee hearing in 2009
- Member of 2011 IARC Working Group for classification of the carcinogenicity of cell phone radiation
- Advised e.g.: Parliament of Finland; National Academies, USA; World Health Organization; Bundesamt für Strahlenschutz, Germany; International Commission on Non-Ionizing Radiation Protection (ICNIRP); Swiss National Foundation; The Netherlands Organization for Health Research and Development;

# Problems associated with the safety standards<sup>4</sup>

- No information whether/how cell phone radiation affects biochemistry of humans
- No certainty that safety standards protect all users from anything besides thermal effects
- Any equipment radiating below currently set safety standards is automatically considered safe, which might be misleading
- Compliance with the safety standards is currently used as an excuse to stop research funding and to continue untamed deployment of new wireless technologies, without any health-related testing
- Non-thermal effects exist but are refused to be acknowledged and studied in depth because of the “excuse” of safety standards
  - Epidemiology and EEG studies provide compelling evidence for the existence of non-thermal effects (=low level exposure effects)

# Macro-scale dosimetry



+

Water  
Salt  
Sugar

=



**The problem:  
free movement of ions**

# IARC evaluation in 2011

- 30 invited experts divided into four sub-groups
  - Dosimetry
  - Epidemiology
  - Animal studies
  - Mechanistic laboratory *in vitro* studies
- Decisions by a consensus or by a simple majority
- The vast majority of 30 experts voted for the classification of cell phone radiation as a possible carcinogen (Group 2B)

# IARC 2011: Epidemiology

- Interphone & Hardell studies
  - no reliable exposure data based on person's memory
  - risk increase in long-term avid users
- Children – only CEFALO
  - exposures for 2-4 years
  - has no statistical power to detect small risk
- Bruce Armstrong, Australia
- Maria Blettner, Germany
- Elisabeth Cardis, Spain
- Lennart Hardell, Sweden
- Peter Inskip, USA
- David Richardson, USA
- Martin Roosli, Switzerland
- Jonathan Sammet, USA
- Malcolm Sim, Australia
- Jack Siemiatycki, Canada

## ...after IARC: Epidemiology (1/2)

- Trend-data - Little et al. 2012: slow rise of brain cancer cases in USA
  - trend is similar to Interphone “prediction” but not Hardell “prediction”
- Danish Cohort update study 2011 – no effect
  - no exposure data but just the length of phone subscription with service provider
- Million Women study 2014 - no effect but exposure data inadequate
  - use of cell phone: ‘never’, ‘less than once a day’, ‘every day’
- CERENAT study from France 2014 – effect as in Interphone and Hardell
  - no reliable exposure data based on person’s memory
- Chapman et al. 2016
  - Misleading claim of 29 years of use and 10 years latency of brain cancer



## ...after IARC: Epidemiology (2/2)

- Interphone – 3 articles from a single set of data
  - Larjavaara et al. 2011: **partial data**; results do not support the hypothesis of gliomas among mobile phone users being preferentially located in the parts of the brain with the highest radio-frequency exposure
  - Cardis et al. 2011: **partial data**; there was weak evidence of stronger associations of glioma and meningioma when a comprehensive estimate of RF dose rather than just mobile phone use was used in the case-control analysis
  - Grell et al. 2016: **full set of data**; statistically significant association between the intracranial distribution of gliomas and the self-reported (possible bias) location of the phone

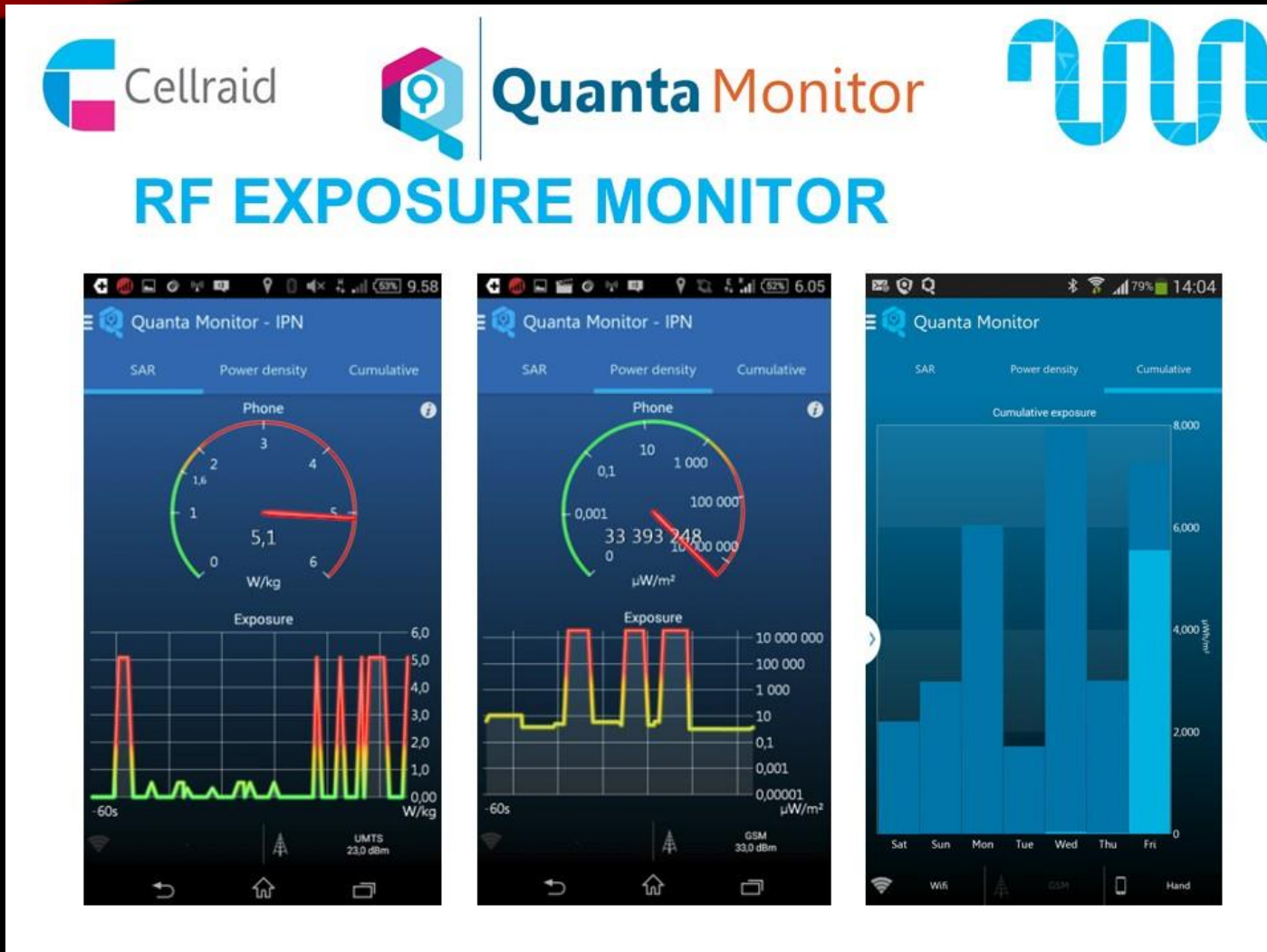
# Epidemiological evidence supports cancer risk<sup>10</sup>

- IARC classification was based on the results of Interphone and Hardell studies
- In 2014, a new epidemiological study was published - the French CERENAT
- The French study reached similar conclusions as Interphone and Hardell previously – **long term avid use of cell phone increases a risk of developing brain cancer**
- Interphone 2016 analysis of full data confirms location of cancer in most exposed part of brain
- Now, there are **three replications of the same epidemiological type of study, the case-control study, that all suggest the cell phone radiation might increase risk of developing brain cancer**

# All epidemiology studies have completely<sup>11</sup> unreliable exposure data

- All epidemiology studies have completely unreliable exposure data
- Length of calls or length of phone subscription with service provider or saying whether you ever or never used cell phone, does not inform about the real exposure of the cell phone user.
- Using the above "exposure data", persons with very different radiation exposures are placed in the same exposed group for statistical evaluation. This dilutes results!
- Ongoing cohort study COSMOS collects exposure data as length of calls!
- There is a way to collect real exposure data by using apps installed on currently used smart phones

# Smart phone app measuring radiation exposure <sup>12</sup>



- App measures cell phone, cell tower and wifi exposures
- For users to follow daily exposures
- For scientists to collect radiation data

There are suggestions, by some scientists that app might overestimate body exposure and SAR. Makers of Quanta disagree with this opinion

# Human studies

- The vast majority are “feelings” studies
  - Subjects asked how they feel and do they feel when radiation is on/off
  - EHS must exist – question is only what is radiation cut-off level
  - Otherwise EMF would be the only factor not causing individual sensitivity
  - Problem of EHS – studied by psychologists not physiologists – wrong methods
  - WHO definition of health – how to consider it? IARC classification justifies reasoning for “*mental and social well-being*”
- Lack of studies examining biochemical responses of human tissues (!)
  - Single skin proteomics study
  - Two studies examined glucose metabolism in the brain

# DNA damage, genotoxicity...

- NTP study fueled debate on genotoxicity of mobile phone radiation.
- Scientifically unfounded “rush to conclusions” on genotoxicity and cancer
- DNA “damage” does not automatically mean that the RF radiation is genotoxic
- DNA damage occurs also spontaneously and is repaired
- No studies to show what is the fate of the RF-induced “DNA damage”
- Is DNA damaged by RF or is RF impairing repair of spontaneous DNA damage?
- Is DNA damage repaired or does it persist in further generations of cells?
- Considering the efficiency of DNA repair mechanisms in cells, claims that mobile phone radiation is genotoxic, are not proven yet.
- We do not know if mobile phone radiation exposure associated DNA damage leads to genotoxicity and mutagenicity or whether it is repaired.

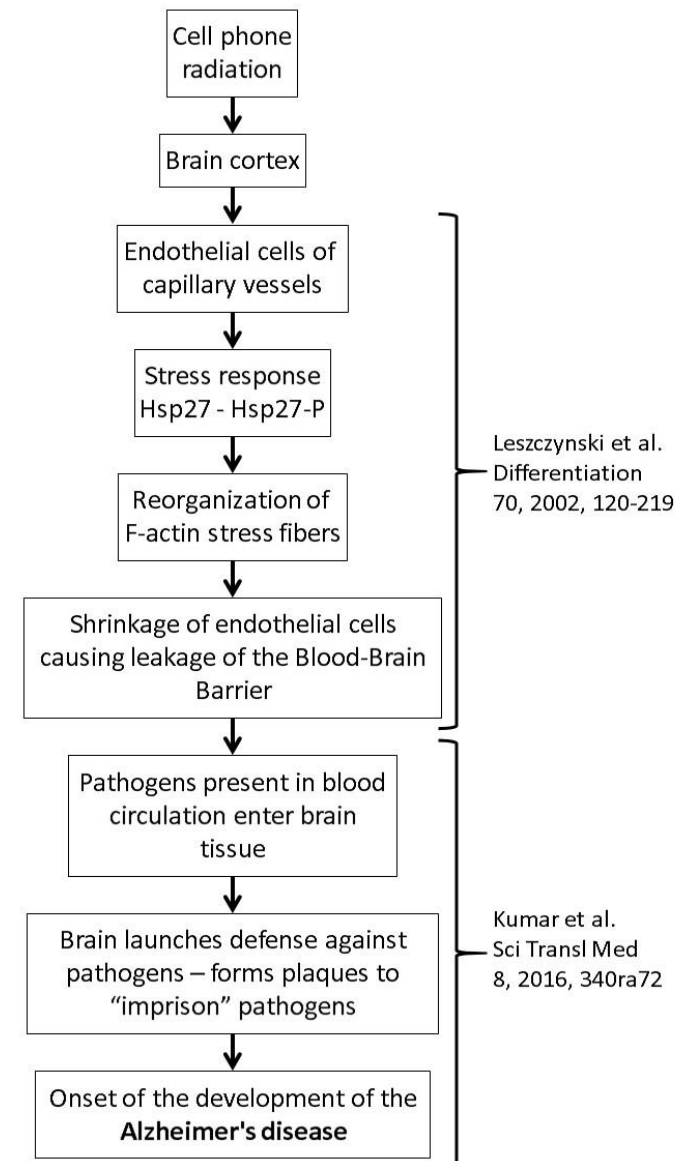
# Alzheimer's disease...<sup>15</sup>

**Table:** Studies examining link between cell phone radiation and Alzheimer's disease

In vitro/In vivo	Experimental model	Exposure	Examined property	Effect	Reference
In vitro	HT22 mouse hippocampal neurons; AD model	CDMA; W-CDMA; combined 837 MHz and 1950 MHz; SAR – 2 W/kg	beta-amyloid protein-induced cytotoxicity	No effect	Lee JS, et al. J Radiat Res (June 20, 2016) doi: 10.1093/jrr/rrw040
In vivo	5xFAD transgenic mice – AD model	W-CDMA; 1950 MHz; SAR – 5 W/kg mean	Memory; Metabolism beta-amyloid protein	No effect	Son Y, et al. Bioelectromagnetics 37, 2016, 391-399
In vivo	C. elegans strain CL4176 – AD model	DECT, WiFi, GSM; 1,790–2,480 MHz	Paralysis of worm	No effect	Fasseas MK, et al. Int J Radiat Biol 91, 2015, 286-293
In vivo	5xFAD transgenic mice - AD model	1950 MHz; SAR 5W/kg	Reduction of beta-amyloid plaques	Yes effect; reduction of AD pathology	Jeong YJ, et al. Curr Alzh. Res 12, 2015, 481-492
In vivo	rats	900 MHz; SAR 0.05 – 0.18 W/kg; whole body	learning & memory; oxidative stress; brain metabolism	Yes effect; brain metabolism; No effect; learning, memory, oxidative stress	Maaroufi K, et al. Behav Brain Res 258, 2014, 80-89
In vivo	AβPPsw+PS1 transgenic mice; AD model	GSM; 918 MHz, SAR - 0.25-1.05 W/kg	Reduction of beta-amyloid plaques	Yes effect	Arendash GW, et al. PLoS One 7, 2012, e35751
In vivo	AβPPsw+PS1 transgenic mice; AD model	GSM; 918 MHz, SAR - 0.25-1.05 W/kg	Mitochondrial function	Yes effect; enhances brain mitochondrial function	Dragicevic N, et al. Neuroscience 185, 2011, 135-149
In vivo	AβPPsw+PS1 transgenic mice; AD model	GSM; 918 MHz, SAR - 0.25-1.05 W/kg	brain beta-amyloid plaques	Yes effect; reduction of beta-amyloid plaques	Arendash GW, et al. J Alzheimers Dis 19, 2010, 191-210
In vitro	Rat primary cortical neurons; cholinergic SN56 cell line	GSM; 900 MHz; SAR - 1 W/kg	25-35AA beta-amyloid as RF co-stressor for oxidative damage of neural cells	Yes effect; only under particular circumstances	Del Vecchio G, et al. Bioelectromagnetics 30, 2009, 564-572

Recently published study [Kumar et al. 2016] proposes a mechanism linking viral and bacterial infections of the brain with the development of Alzheimer's disease. The authors suggest that the development of the Alzheimer's disease would be an off-shot of the immune defense mechanism. Beta-amyloid plaques are suggested to produced to trap pathogens.

### Hypothesis: RF-EMF exposure & Alzheimer's





# Wi-Fi, smart meters and others

- Lack of studies relevant to human health risk estimate
- EMF Portal specialized database in Germany
  - Wi-Fi studies - just few
  - Smart meters - no studies listed at all
- Wi-Fi; epidemiology – 23 studies – some recent examples
  - Guxens et al 2016 – 2354 cases; no effect
  - Calvente et al. 2016 – 123 cases; no effect
  - Abad et al. 2016 – 462 cases; no effect “*may be due to small sample size*”
  - Roser et al. 2016 – 439 cases; no effect
  - Schoeni et al. 2015 – 439 cases; memory affected

# Invoking the Precautionary Principle

“Whether or not to invoke the Precautionary Principle is a decision exercised where **scientific information is insufficient, inconclusive, or uncertain** and where **there are indications** that the possible effects on environment, or human, animal or plant health may be **potentially dangerous** and **inconsistent with the chosen level of protection.**”

# Reasons for invoking the Precautionary Principle

Scientific information is insufficient, inconclusive, or uncertain

- IARC classification as possible carcinogen (Group 2B)

There are indications that the possible effects on human health may be potentially dangerous

- epidemiological studies from Interphone, Hardell and CERENAT show an increased risk of brain cancer in long-term avid users

Inconsistent with the chosen level of protection

- epidemiological studies, showing increased risk in long-term avid users, were generated in populations using regular cell phones, meeting current safety standards = current safety standards are insufficient to protect users
- epidemiological studies provide compelling evidence for non-thermal effects (=effects at low level exposures)

# The impact of implementing the Precautionary Principle

- **Precaution** does not equal **Prevention**
- Strong opposition from telecom industry
  - Technology providers can be made responsible to prove their product is safe
  - Requirement of making more efficient (less radiation emissions) technology
  - Limiting current rampant and uncontrolled deployment of wireless networks
- Will create new knowledge through research
- Will create new jobs in research and technology

# Conclusions (1/2)

- IARC classification of cell phone radiation as a possible carcinogen is a sufficient reason for invoking Precautionary Principle
- Claims that the current safety standards protect all users are not supported by the scientific evidence
- Users should be informed about the current scientific uncertainty and advised to limit exposures whenever possible and feasible and strongly discouraged from keeping cell phones close to body (in pockets)
- Real radiation exposure data should be used in epidemiological studies
- ALARA principle should be implemented for cell phone radiation exposures
- Activity of WHO EMF Project and memberships of ICNIRP and SCENIHR should be overhauled... and clear accountability rules should be set

# Conclusions (2/2)

- How probable are health effects of radiation from wireless transmitting devices?
  - IARC 2011 – **possible** cancer
  - Current evidence in 2016 on cancer – rather **probable** than possible
  - Cancer will remain **rare disease**
  - Wireless radiation might be acting solely as **co-carcinogen**
    - hence very slow increase in spite of huge number of users;
    - impact of latency difficult to estimate
  - Other diseases – too limited evidence to draw any reliable conclusions