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# CELL PHONE RADIATION, HEALTH HAZARD AND PRECAUTION

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Presentation is available on the science blog:  
**'BRHP – Between a Rock and a Hard Place'**

# WHO I AM... EDUCATION AND WORK

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

# WHO I AM... EXPERT EXPERIENCE

- 20 years of experimental work on EMF and health
- Testified and advising
  - Parliament of Finland, several
  - US Senate Appropriations Committee hearing; 2009
  - India's Minister of Health and Family Welfare; 2014
  - Canadian Parliament's House of Commons' hearing; 2015
- Member of 2011 IARC (International Agency for Research on Cancer) Working Group for classification of the carcinogenicity of cell phone radiation
- Advised e.g.: Parliament of Finland, US National Academies, 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

## WHO DEFINITION OF HEALTH

*“Health is a state of complete physical, **mental and social well-being** and not merely the absence of disease or infirmity.”*

- According to the WHO, when people are worried by radiation exposure, and stressed by this worry, this is a health effect

# THE WORLD WE LIVE IN...

- Wireless technology is omnipresent and expands exponentially
- Implementation of any device meeting safety standards is freely permitted
- Future 5G networks and Internet of Things will dramatically expand penetration of wireless devices and exposures to radiation
- Public demand for capacity drives wireless expansion
- Technology is far ahead of any biomedical research
- Testing of possible health effects of radiation emitted by wireless devices is done post-deployment



# CELL PHONES WERE NOT TESTED FOR HUMAN HEALTH HAZARD BEFORE MARKETING

- In early 1980s communications technology developed for the **US Department of Defense** was commercialized without any testing for health effects
- **US Food and Drug Administration (FDA)** allowed cell phones to be sold without pre-market testing for human health hazard
- FDA rationale - the “**low power exclusion**”

# EFFECTS: THERMAL vs. NON-THERMAL

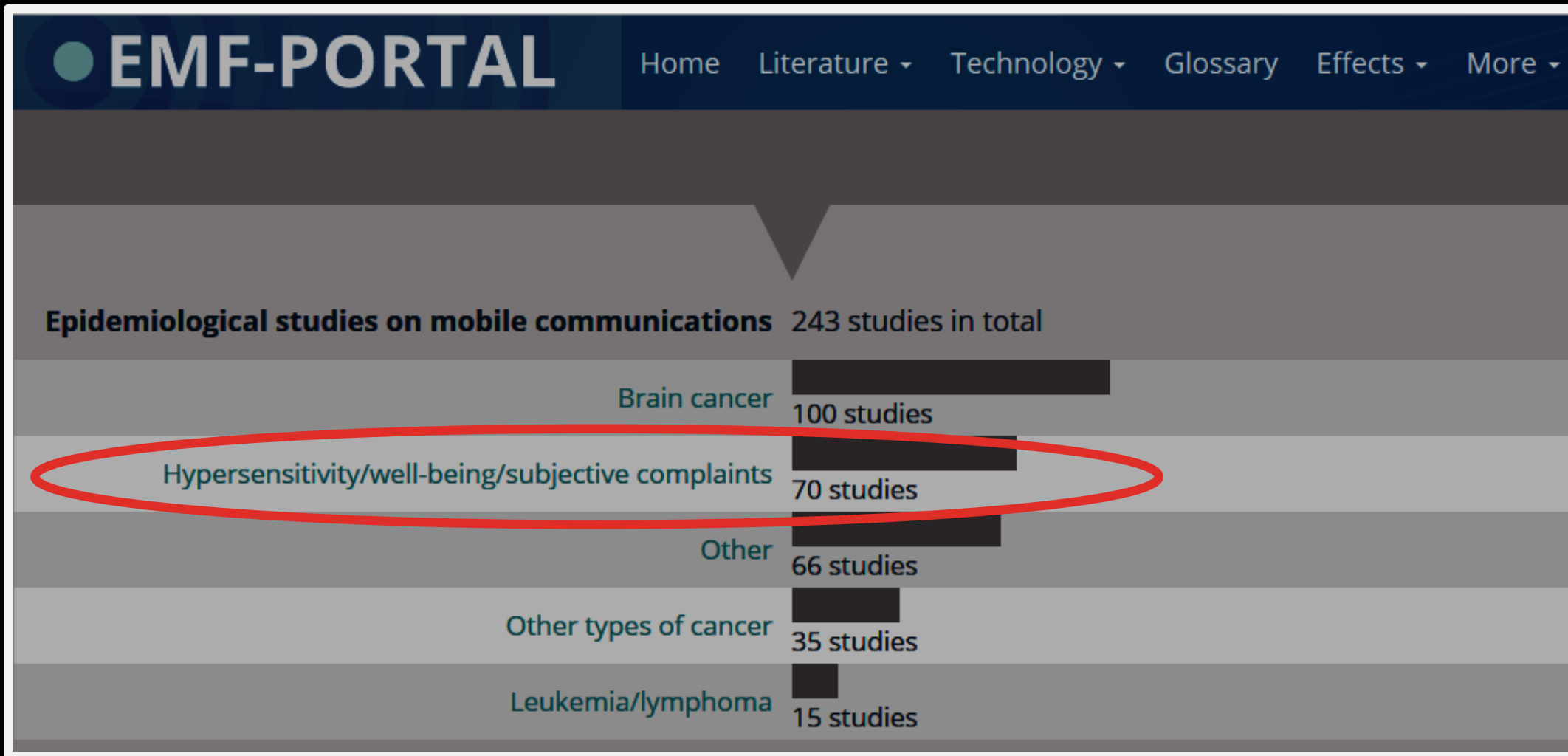
- Terms 'thermal' and 'non-thermal' effects cause confusion
- Better term: '*effects at low level exposures*' = exposures at or below levels permitted by the current safety limits
- Effects at low level exposures = non-thermal effects – **do exist**
- **Epidemiology and EEG studies provide compelling evidence, in humans, for the existence of low level exposure effects (=non-thermal effects)**
  - Epidemiology studies show effects for the regular cell phones
  - EEG shows effect, even if it is not harmful it is effect at low level exposure



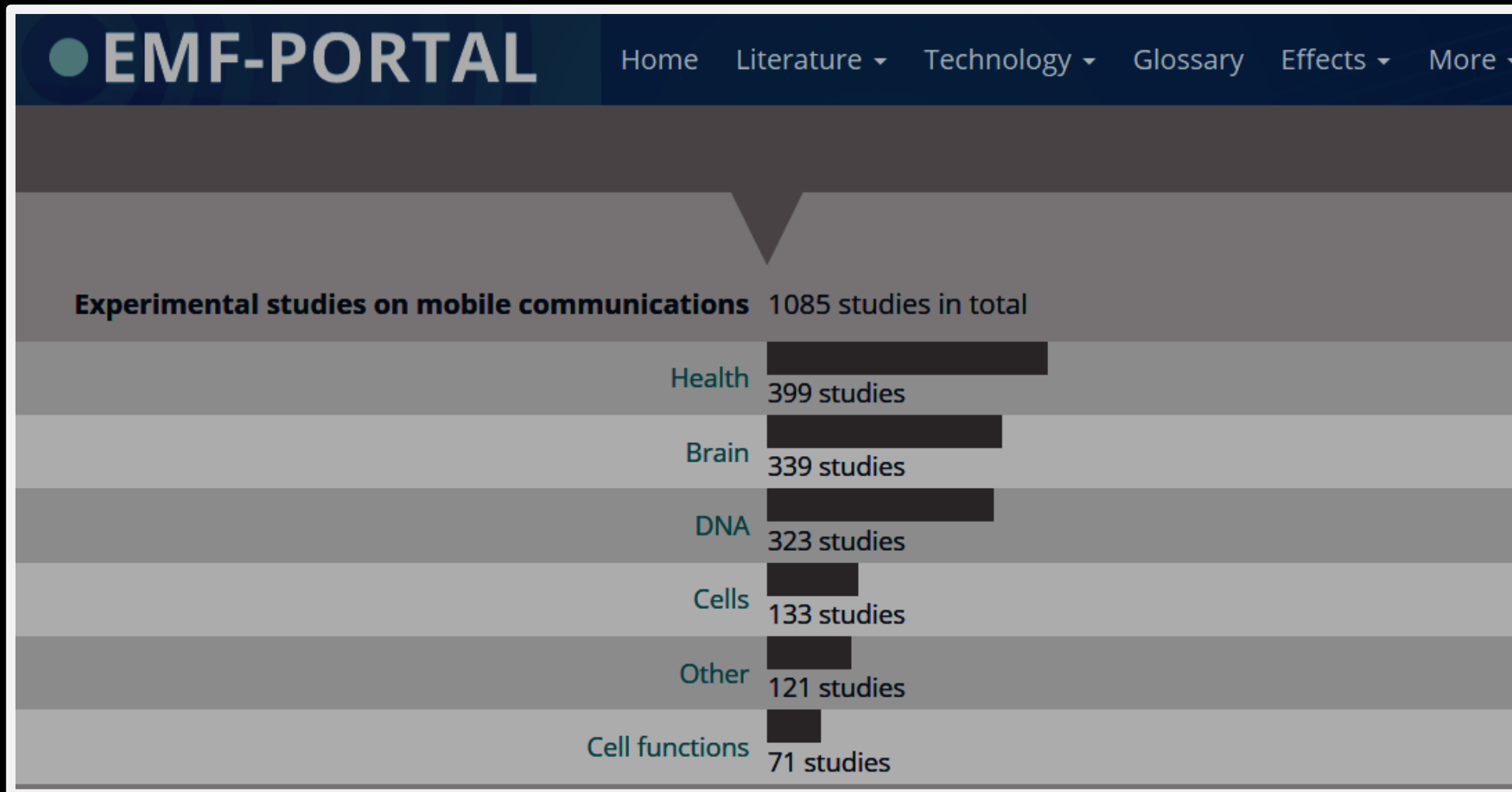
# LIMITED BIOMEDICAL RESEARCH ON CELL PHONE RADIATION & HEALTH

- The vast majority of EMF research done on non-cell phone frequencies
- EMF Portal ([www.emf-portal.org](http://www.emf-portal.org)) listing as of December 13, 2016
- Total number of studies on cell phone radiation = 1328
  - Epidemiological studies = 243
  - Experimental studies = 1085 (human, animal, in vitro)
- Very many studies of low scientific standard
- Very many studies useless for human health risk estimation
- Lack of studies examining responses of human physiology to exposure
- Lack of studies on chronic exposures, majority examines only acute responses

# EPIDEMIOLOGICAL STUDIES



# EXPERIMENTAL STUDIES



# IARC 2011: EPIDEMIOLOGY

- EU Interphone project & Hardell studies from Sweden
  - no reliable exposure data based on person's memory
  - risk increase in long-term avid users – 30min/day for 10+ years
- Children – only CEFALO
  - exposures for 2-4 years
  - has no statistical power to detect a small risk

# ...AFTER IARC: EPIDEMIOLOGY<sup>13</sup>

(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 in the UK, 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. in Australia, 2016
  - Misleading claim of 29 years of use and 10 years latency of brain cancer

# ...AFTER IARC: EPIDEMIOLOGY<sup>14</sup>

(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

- 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 has shown that brain cancer develops in the most radiation-exposed part of brain
- Now, there are **three replications of the same type of epidemiological study, the case-control study, that all suggest the cell phone radiation might increase risk of developing brain cancer**

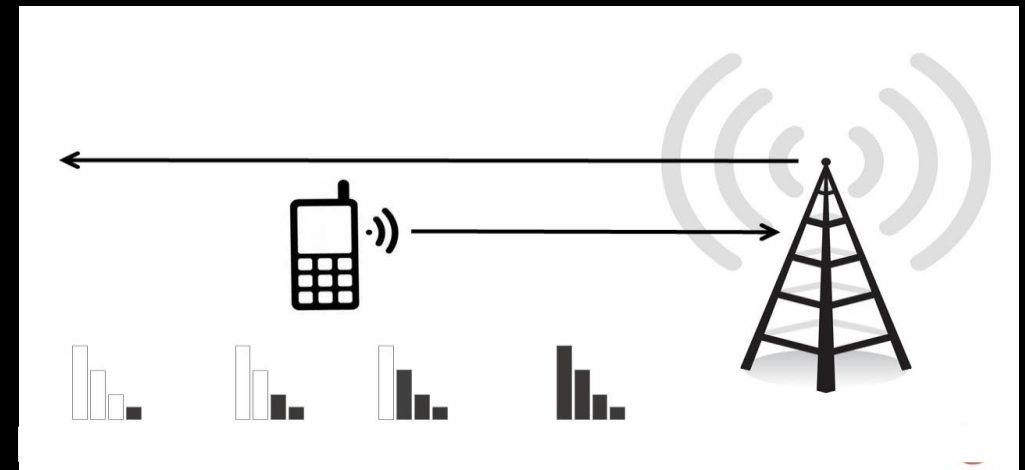
# ALL EPIDEMIOLOGY STUDIES HAVE COMPLETELY UNRELIABLE EXPOSURE DATA

- 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 exposure group for statistical evaluation. **This dilutes severity of 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**

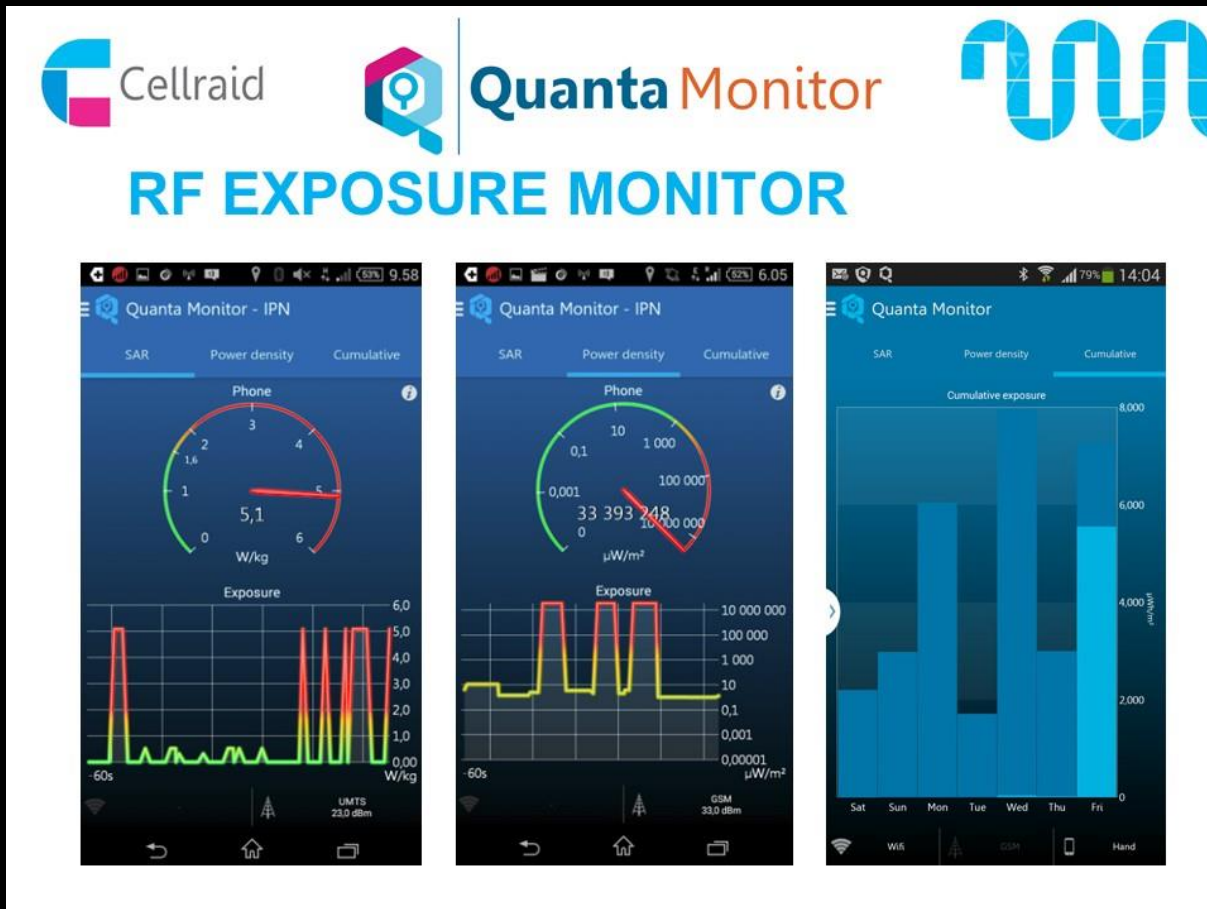
# EPIDEMIOLOGY WITH NO RADIATION DATA

- When study shows no effect this does not prove lack of effect
- When study shows effect this does not prove that effect exists but...
  - ...it indicates that effect is possible/probable because **effect is seen even in situation when a very poor radiation exposure data is used...**
  - ...currently used exposure data underestimates (dilutes) the effect...
  - ...and here is why...

**Two persons talking for the same length of time may have entirely different radiation exposure because of the different proximity to cell tower**



# SMART PHONE APP MEASURING RADIATION EXPOSURE



- 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 were asked how they feel and do they feel when radiation is on/off
  - ‘Feelings’ studies will not answer whether EHS exists
  - **EHS must exist, otherwise EMF would be the only factor not causing individual sensitivity**
  - **Problem:** EHS was studied by psychologists not physiologists – use of wrong methods
- Lack of studies examining biochemical responses of human tissues (!)
  - Single skin proteomics study
  - Two studies examined glucose metabolism in the brain

# ANIMAL STUDIES

- Limitations to toxicology research
  - Not possible to overdose cell phone radiation because of heating effect
  - Life-time exposures to radiation at doses similar to those emitted by cell phones show no effect – result is useless for human health risk estimation
- **Misleading claims** that because animal studies, performed with cell phone radiation levels, do not show effects means that people are safe
  - **When animal does not react it does not automatically mean human will not react**
- **Co-carcinogen** studies show some effects – cell phone radiation might potentiate effects of carcinogenic chemicals or radiation
  - **Published replication of Tillmann et al. 2010 confirmed by Lerchl et al. 2015**



# GAME CHANGERS AFTER 2011 IARC

## strengthening the evidence for carcinogenicity of cell phone radiation

- Epidemiology
  - Coureau G, et al. Mobile phone use and brain tumours in the CERENAT case-control study. *Occup Environ Med.* 2014; 71: 514-522
  - Grell et al. The Intracranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study. *Am J Epi.* Nov. 2016; DOI: 10.1093/aje/kww082
- Animal studies – Lerchl’s group replication of Tillman et al study
  - Lerchl A, et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *BBRC* 2015; 459: 585-590
- Dosimetry – reevaluation of in vitro dosimetry by Schmid & Kuster
  - Schmid G & Kuster N. The discrepancy between maximum in vitro exposure levels and realistic conservative exposure levels of mobile phones operating at 900/1800 MHz. *Bioelectromagnetics.* 2015; 36:133-148

In my opinion, the currently available scientific evidence from epidemiology and animal studies is sufficient to upgrade the carcinogenicity of cell phone radiation from the possible carcinogen (Group 2B) to the probable carcinogen (Group 2A).

Dariusz Leszczynski

# CURRENT SAFETY LIMITS ARE INSUFFICIENT

Current safety limits given as Specific Absorption Rate (SAR) are from 1998

- General public: 2 W/kg (head & trunk), 4 W/kg (limbs)

Update of safety limits is delayed by several years

- WHO – EHC Environmental Health Criteria – delayed
- ICNIRP – safety limits delayed because they await outcome of WHO EHC
- ICNIRP draft document ready for commenting in the end of 2017 (?)

Epidemiological studies, showing **increased risk of glioma** in long-term avid users, were generated in populations using regular cell phones, **compliant with safety standards**

- current safety standards are insufficient to protect users

# REASONS FOR INVOKING PRECAUTIONARY PRINCIPLE FOR CELL PHONE RADIATION ARE FULFILLED

Scientific information is insufficient, inconclusive, or uncertain

- IARC classification, as possible carcinogen (2B), says exactly this = scientific information on cell phone radiation and health is insufficient, inconclusive, or uncertain

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

- Glioma is dangerous; epidemiological studies from Interphone, Hardell and CERENAT studies show an increased risk of glioma 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, compliant with safety standards = current safety standards are insufficient to protect users

# GAPS IN RESEARCH

- **Some examples** (not exhaustive list)
  - Epidemiology with actual radiation exposure data
  - Search for sensitive sub-population using biochemistry methods
  - Finding out if DNA damage happens in people
  - Examining whether human blood-brain barrier is affected
- Lack of clear vision from funders what is needed for health risk estimate
- Scientists responsible for “creating and maintaining” gaps in research
- Poor supervision from funding agencies of usefulness of proposed research for human health risk evaluation

# Wi-Fi, smart meters and others

- Lack of studies relevant to human health risk estimate
- EMF Portal database
  - 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

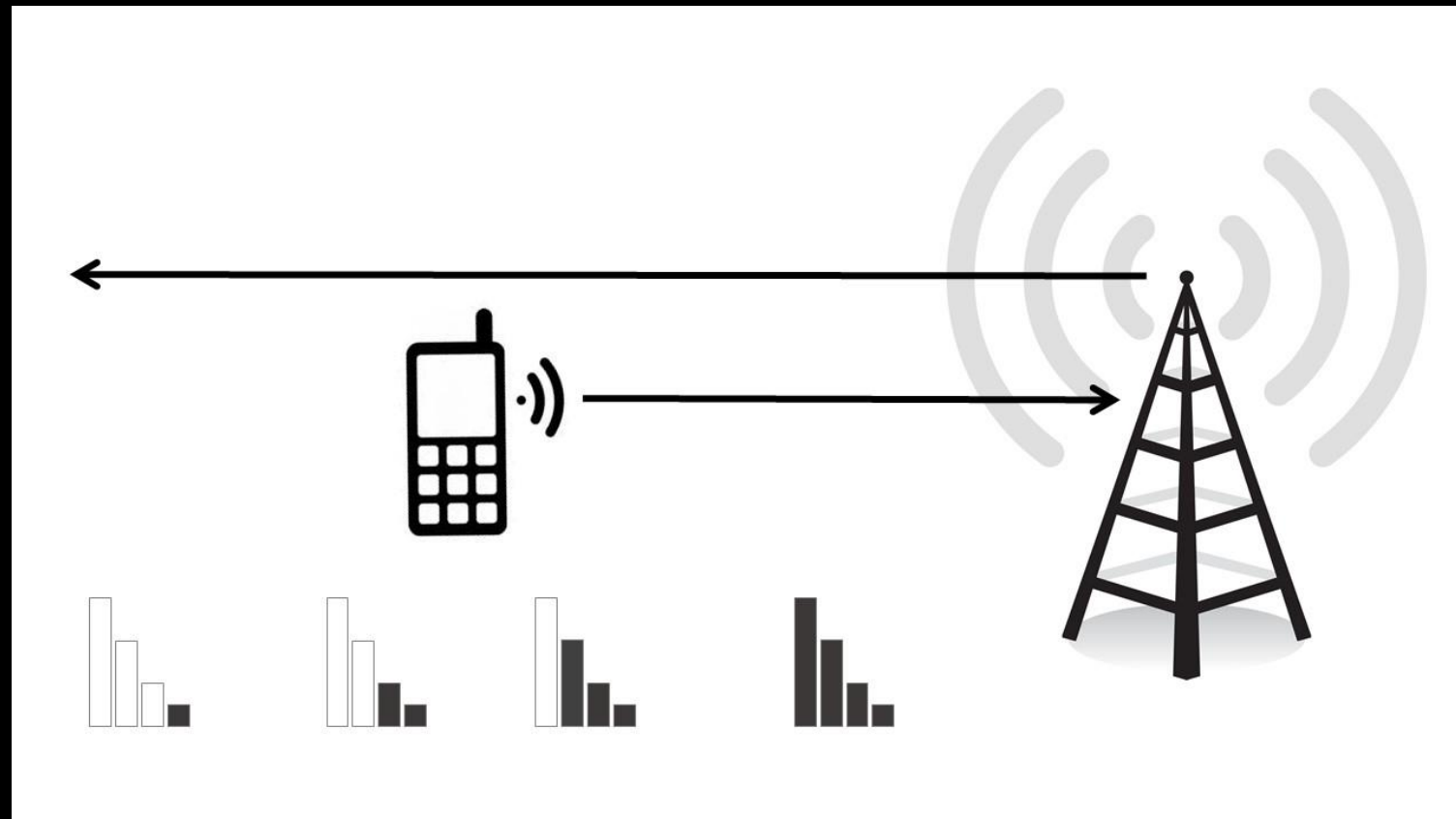


# DNA damage, genotoxicity...

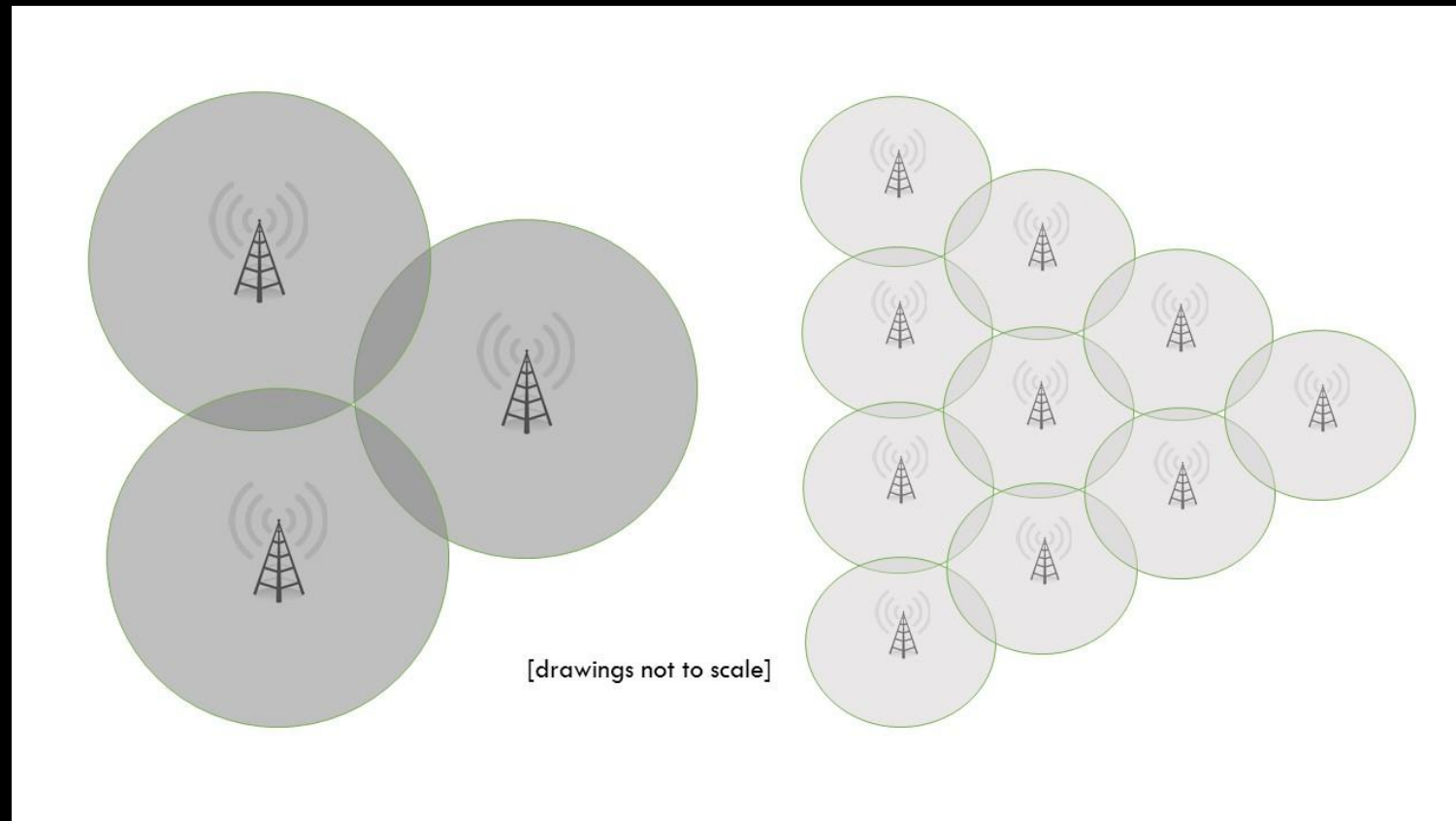
- **NTP study** fueled debate on genotoxicity of mobile phone radiation.
- Scientifically unfounded “rush to conclusions” on genotoxicity and cancer
- DNA damage does not automatically mean that the radiation is genotoxic
- DNA damage occurs also spontaneously and is repaired
- No studies to show what is the fate of the radiation-induced DNA damage
- Is DNA damaged by radiation or is radiation affecting 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.

# CELL TOWERS

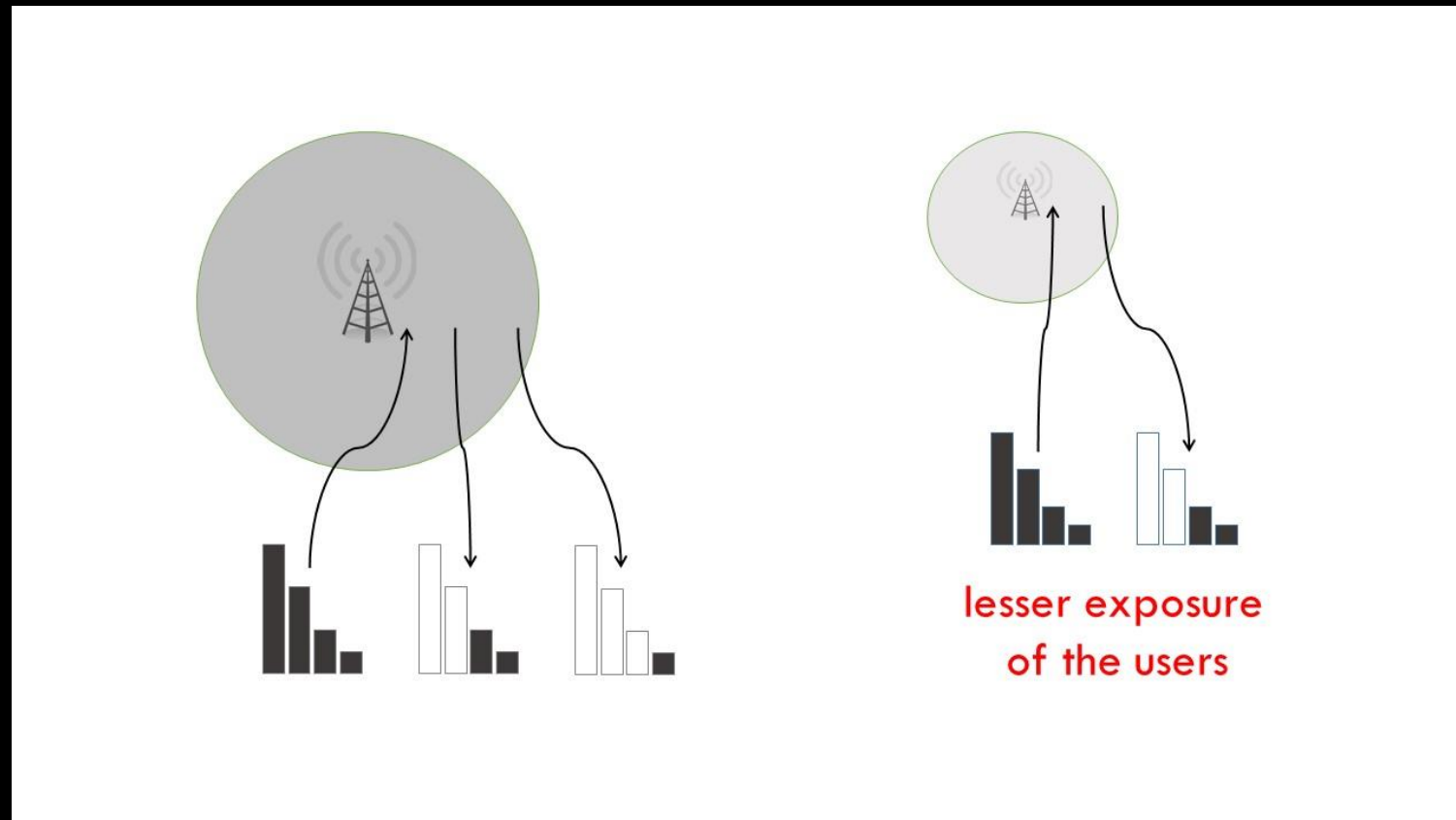
# IMPACT OF PROXIMITY OF CELL TOWER ON CELL PHONE EXPOSURE



# DENSITY AND POWER OF CELL TOWERS TO COVER THE SAME AREA



# DENSER LOCATION OF TOWERS WITH LOW POWER = LESSER EXPOSURE TO USERS



# CONCLUSIONS (1/4)

- 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 **better informed** about the current scientific uncertainty and **strongly 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



# CONCLUSIONS (2/4)

- How possible or probable are health effects of wireless radiation?
  - 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

# CONCLUSIONS (3/4)

- Non-cancer diseases – too limited evidence to draw any reliable conclusions
- Effects of cell towers, wi-fi, smart meters – too limited evidence to draw any health-related conclusions
  - Any claims that cell towers, wi-fi and smart meters are safe or are dangerous have no support in science
- Sensitivity to EMF – urgent need for physiological studies
  - To date executed psychological studies of EHS are insufficient to provide evidence of existence or evidence of absence of EHS

# CONCLUSIONS (4/4)

There is an urgent need for a comprehensive overhaul of all research efforts to focus on supporting studies that will provide data directly usable for human health risk estimate.

Dariusz Leszczynski