WIRELESS RADIATION AND HEALTH
THE CASE FOR THE PRECAUTIONARY PRINCIPLE FOR THE CURRENT AND THE FUTURE 5G & IoT TECHNOLOGY

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WHO I AM... EDUCATION AND WORK

• Two doctorates in molecular biology and biochemistry/cell biology
• Adjunct Professor of Biochemistry, University of Helsinki, Finland
• Currently retired (2018)
• Independent Expert; actively advising and lecturing (2014 - present)
  • 22 years (1992-2013) at STUK – Radiation and Nuclear Safety Authority in Finland
  • 2003-2007 as Head of Radiation Biology Laboratory
  • 2000-2013 as Research Professor
• Assistant Professor at Harvard Medical School, USA; 1997-1999
• Guangbiao Professor at Zhejiang Univ., Hangzhou, China; 2006-2009
• Visiting Professor at Swinburne Univ. Technology, Melbourne, Australia; 2012-2013
WHO I AM… EXPERT EXPERIENCE

• 20 years of experimental work on EMF and health
• Testified and advised
  • Polish Ministry of Digitization; 2016
  • Canadian Parliament’s House of Commons’ hearing; 2015
  • India’s Minister of Health and Family Welfare; 2014
  • USA Senate Appropriations Committee hearing; 2009
  • Parliament of Finland
• Member of 2011 International Agency for Research on Cancer (IARC) Working Group for classification of the carcinogenicity of cell phone radiation
• Advised e.g.: 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;
THERE ARE THINGS WE KNOW THAT WE KNOW.

THERE ARE KNOWN UNKNOWNS. THAT IS TO SAY THERE ARE THINGS THAT WE NOW KNOW WE DON'T KNOW.

BUT THERE ARE ALSO UNKNOWN UNKNOWNS. THERE ARE THINGS WE DON'T KNOW WE DON'T KNOW.

Donald Rumsfeld, US Secretary of Defense, NATO Briefing, June 6, 2002
[http://www.nato.int/docu/speech/2002/s020606g.htm]
HUMAN HEALTH POLICIES

Policies concerning human health and wireless technology are based solely on "what we know that we know".

“What we know that we do not know” is dismissed as irrelevant (case of not done yet research !)
WORLD HEALTH ORGANIZATION: 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, it is a health effect when people are stressed and concerned by the worry of radiation exposure.
- This applies to all wireless communication technologies.
- The larger the “worried” or “concerned” population is, the larger the health problem is.

Dariusz Leszczynski, 22nd Korean EMF Workshop, Seoul, South Korea, August 30, 2018
Cell Phones: The Assumed Lack of Health Hazard Appears to Be False

- In early 1980s communications technology developed for US Department of Defense was put into commerce
- 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”
- In 2011, based on the post-deployment research, International Agency for Research on Cancer (IARC) classified cell phone radiation as a possible human carcinogen
• International Agency for Research on Cancer 2011 classification was based on the results of Interphone and Hardell studies

• Currently, the four case-control epidemiological studies suggest the cell phone radiation increases risk of developing brain cancer in avid users
  • Regular user (!) – no problem at all but... definition: 1 call/week for 6 months
  • Avid user = ca. 30 minutes/day for 10+ years
  • Interphone 40%; Hardell 170%, CERENAT 100%, Canadian Interphone 100% increase in glioma risk

• Interphone 2016 analysis of full data confirms location of cancer in the most exposed parts of brain

• NOTICE: all case-control studies underestimate risk of brain cancer because of poor radiation dosimetry
Epidemiology case-control studies have no radiation exposure data

- Surrogate for radiation exposure – minutes of using cell phone
- Such surrogate leads to **underestimation** of the effect
- Two persons talking for the same length of time may have entirely different radiation exposure because of the different proximity to cell tower
- **Persons with dramatically different radiation exposure are analyzed as if having the same exposure** because they have the same minutes of use
- Epidemiology **underestimates** cancer risk
HUGE NUMBER OF CELL PHONE USERS BUT NO DRAMATIC INCREASE IN BRAIN CANCER IN WHOLE POPULATION

• Brain cancer – rare disease

• Cancer latency is tens of years

• Length of use of cell phone and how avidly used

• Cancer statistics are too general – do not differentiate between types of brain cancer or age groups having it – might be misleading (e.g. men 50-79)

• Cancer cause – cell phone radiation only a co-inducer of cancer?

• Individual sensitivity – not everyone reacts to this low-power radiation
Because the PP deals with risks with poorly known outcomes and poorly known probability, the unquantified possibility is sufficient to trigger the consideration of the PP. This distinguishes the PP from the prevention principle: if one does have a credible ground for quantifying probabilities, then the prevention principle applies instead.
CONDITIONS FOR 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...”
INVOKING THE PRECAUTIONARY PRINCIPLE IS JUSTIFIED

- **Scientific information is insufficient, inconclusive, or uncertain**
  - IARC classification of cell phone radiation as possible carcinogen (Group 2B) means that the science is insufficient, inconclusive, and uncertain

- **There are indications that the possible effects on human health may be potentially dangerous**
  - Epidemiological studies, Interphone, Hardell, CERENAT, Canadian Interphone show an increased risk of brain cancer in long-term avid users – potentially dangerous effect

- **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 the current safety standards = current safety standards are insufficient to protect users
THE IMPACT OF IMPLEMENTING THE PRECAUTIONARY PRINCIPLE

• Consideration and implementation of the Precautionary Principle (PP) does not equal prevention of the use of wireless communication technology

• Strong opposition from telecom industry because implementation of PP may cause:
  • Technology providers can be made responsible to prove their product is safe – this may require telecoms to fund expensive bio-med research
  • Requirement of making more efficient (less radiation emissions) technology
  • Limiting current rampant and uncontrolled deployment of wireless networks (not possible with 5G technology)

• Implementation of PP will create new knowledge through research

• Implementation of PP will create new jobs in research and technology
CLAIMS THAT THE PRECAUTIONARY PRINCIPLE IS SUFFICIENTLY IMPLEMENTED IN THE CURRENT SAFETY LIMITS ARE NOT SUPPORTED BY THE SCIENTIFIC EVIDENCE INDICATING AN INCREASED HEALTH RISK, E.G. DEVELOPING BRAIN CANCER BY THE LONG-TERM AVID USERS OF CELL PHONES.
RADIATION EXPOSURES CHANGE

USERS ARE UNDER-INFORMED

• **Laptops**, old, did not emit wireless radiation – keeping on the lap was **OK**
• **Laptops**, new, connect to internet, emit wireless radiation – keeping on the lap is **not OK**
• **Tablet**, connect to internet, emit wireless radiation – keeping close to the body is **not OK**
• **Cell phones**, non-smart,
  • emitted radiation when speaking/listening; on idle radiation emission was negligible
  • it was **OK** to keep in the pocket
• **Smart phones**
  • emit radiation when speaking/listening
  • when connected to internet - synchronizing apps
  • when using as base-station (tethering)
  • it is **not OK** to keep in pocket smart phone connected to internet
5G TECHNOLOGY

Source: IEEE Spectrum
http://spectrum.ieee.org/video/telecom/wireless/everything-you-need-to-know-about-5g
SERIOUS LIMITATIONS OF BIOMEDICAL RESEARCH ON MILLIMETER-WAVES

- Very limited number of studies
  - EMF Portal (www.emf-portal.org) lists <200 studies
  - Few more studies possible to find in PubMed database
- Lack of studies examining responses of human physiology to exposure (human volunteer studies)
- Complete lack of studies on chronic, long-term, exposures
- Studies from a very limited number of research groups (!)
- Lack of replication studies confirming correctness of observations (!)
ENVIRONMENT OF HUMAN SKIN

[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• False assumption that because radiation will be absorbed by skin only there will be no major health problem

  • “...The skin, the human body’s largest organ, is home to a diverse and complex variety of innate and adaptive immune functions...”
  • “…the skin immune system should be considered a collective mixture of elements from the host and microbes acting in a mutualistic relationship...”

Dariusz Leszczynski, 22nd Korean EMF Workshop, Seoul, South Korea, August 30, 2018
HUMAN VOLUNTEER STUDIES ON MILLIMETER-WAVES

[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• Just a *handful* of studies with a *trickle* of information
  • Local skin heating
  • Effect on pain sensation
  • Effect on acupuncture sites
  • Effects on blood flow

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IN VITRO EFFECTS ON HUMAN CELLS
[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• Just a couple of hundreds of studies, with effects and without effects
  • Promotion of synthesis of extracellular matrix
  • Induction of apoptosis
  • Promotion of proliferation and G1 to S phase transition
  • Inhibition of NO-dependent apoptosis via p38MAPK pathway
  • Changes in protein expression
  • Effects on NF-KB pathway via TNF-alpha and cyclophosphamide
  • Effects on c-fos expression
  • Lack of effects on Hsp27 and Hsp70 (no thermal effect?)
  • Number of studies shows the opposite, no effects…
EFFECTS ON MICROBES (SKIN & ELSEWHERE)
[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• Just a handful of studies (<20?)
  • Inhibition of bacterial growth (53 GHz)
  • Enhancement of bacterial sensitivity to antibiotics (53 GHz)
  • Inhibition of growth and viability of bacteria (70 GHz)
  • Effects on metabolic pathways in bacteria (53 GHz)
  • Co-effects of mm-Waves and UVC (enhanced survival)
  • Co effects with X-rays (repair of the damage)
  • Effects on structure if bacterial genome
SPECIFIC “ELECTROMAGNETIC EFFECT”
[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

  • Exposure affected gene expression
  • Seven genes affected and confirmed
  • Effect observed when temperature of cells increased
  • When temperature was controlled effect disappeared but…
  • …just by increasing temperature it was not possible to mimic the thermal-exposure effect on genes
  • Hence, proposed possibility of an “electromagnetic” component of the exposure effect
SENSITIVITY OF INSECTS (E.G. BEES)  
[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz. Thielens et al. (team included Luc Martens and Wout Joseph); Scientific Reports 2018, 8:3924

• “...Our simulations showed that a shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3–370%...”

• “...This could lead to changes in insect behaviour, physiology, and morphology over time due to an increase in body temperatures, from dielectric heating...”

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INDIVIDUAL SENSITIVITY

[EXAMPLES, NOT A COMPREHENSIVE OVERVIEW]

• At 42 GHz effect on human blood cells depended on the dose radiation and on the “individual peculiarities of donors of the blood cells” (study from 1998)

• Skin of different people reacts differently to stimuli – will it happen with millimeter-waves… we have no idea because we did not examine it at all

• It is likely that the majority of population will not be affected by exposures but it is also likely that there is a more sensitive subpopulation; it should be discovered and protected

• Research on physiological effects of millimeter-waves on skin, and its impact on the whole body physiology, is urgently needed
INDUSTRY FUNDED REVIEW STUDY: AN UNFOUNDED CLAIMS OF SAFETY FOR 5G


• In April 2014, the Brooklyn 5G Summit, sponsored by NOKIA and the New York University (NYU) WIRELESS Research Center

• Assumption: low-power = not causing health effects because it is non-thermal

• “...Compared with lower frequency bands, relatively little careful research has been conducted evaluating the potential of *more subtle long-term effects* than tissue damage due directly to heating at mmWave frequencies…”

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DÉJÀ VU?

• Cell phones 1G – 4G
  • 1G technology emitting low power - no health hazard envisioned in 1980’s
  • Today – 3G & 4G – technology emitting low power – classified by WHO/IARC as a possible human carcinogen

• Future 5G and Internet of Things (IoT)
  • Technology emitting low power – assumption of no health hazard
  • No research to support assumption because no research done (!)
  • The future research outcomes are enigma… but deployed 5G will remain deployed, no matter what warnings might come from the science
PREDICTABLE FUTURE WITH 5G

• Base stations networks will be deployed first, followed by…

• Gadgets in pockets…
  • “No one is ready with components small enough for handsets; those will come later. Laptops are and tablets are likely to get 5G connectivity before 5G handsets appear.”

• Users will be exposed in addition to 3G and 4G radiation to the new type of radiation – the millimeter-waves

• Current talk that users will not be exposed in close-range to millimeter-waves is incorrect… initially will not but later will be

Source: https://www.edn.com/electronics-blogs/5g-waves/4458814/Movandi-optimizes-mmWave-5G-front-ends

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ONCE DEPLOYED...REMAIN DEPLOYED... 
NO MATTER WHAT THE POST-DEPLOYMENT 
SCIENCE WILL SAY

• Network operators’ revenue opportunity for wireless connectivity is likely to exceed $3 trillion ($3,000,000,000,000) by 2026, with the vast majority of revenue growth coming from new industrial applications powered by 5G (report from Ericsson)

• The 5G-enabled health services segment alone will be worth $1.1 trillion by 2035 (report from Qualcomm)

Source: https://www.edn.com/electronics-blogs/5g-waves/4459091/5G--Its-the-use-cases--dummy
CONCLUSIONS

• Current science justifies the implementation of the Precautionary Principle for the 3G and 4G technologies

• Limiting unnecessary exposures is achievable with 3G and 4G technologies

• Limiting unnecessary exposures with 5G will be impossible

• Safety limits for radiation exposure will be of paramount importance in 5G because the avoidance of exposures will be impossible

• The need of research is very urgent because of the rapidly ongoing deployment of 5G technology and lack of knowledge about effects of the mm-waves

• Delay in the massive deployment of the 5G is advisable, to gather the appropriate science