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I have served on the New Hampshire Committee on the Environmental and Health Effects of Evolving 5G Technology (2020).

I am currently part of the HHS Committee reviewing Scientific Evidence, Regulatory Analysis, and Policy Recommendations on Electromagnetic Radiation Health Effects.

I have been involved in EMR safety for about 35 years and currently serve as the vice-chair of ICBE-EMF (ICBE-EMF.org), a scientific organization specifically oriented to the improvement of RF safety limits.

ACKNOWLEDGEMENT OF THE PROBLEM

In the US, the biological and health effects of electromagnetic radiation (EMR) at ELF and RF frequencies are being recognized, and concrete action is envisaged to attenuate them in the general population.

HEALTH IMPACTS TO CONSIDER

Investigations of the past have focused on cancers, fertility/reproductive impacts and chronic neurological or metabolic conditions.

A major mechanism by which EMR acts on biological function is interference with the electron and proton currents of oxidative phosphorylation (OXPHOS) in mitochondria. Since all cells in the body depend on this mechanism, the diseases that could occur downstream are wide-ranging. The health impacts could easily be confounded with diseases already long present in the population, so good studies must be conducted to isolate the effect specifically related to EMR. The fact that both ELF and RF exposures are associated with increased concentrations of Reactive Oxygen Species (ROS) also argues to widen the scope of possible pathologies beyond those previously scrutinized.

INVESTIGATION

Past experience with genetic (as opposed to environmental) mitochondrial disease indicates that multiple organ systems are affected, that organs or processes with high energy demands will be affected acutely, but that chronic effects could involve more organs or processes.

It is also expected that extreme clinical heterogeneity can occur within a single person, family or among experimental animals, making full detection of EMR health impacts a more difficult challenge than what is classically encountered in toxicology. EMR literature is handicapped by the fact that control references, environments representing true pre-industrial conditions, are rarely achieved in experiments, particularly for ELF radiation. Most reports document differences between two levels of exposure as opposed to the absolute effect of EMR.

Past methods of Public Health have often involved investigations of single chemicals with 3-5 doses for animal experiments in toxicology or of groups similarly segmented for exposure in epidemiology. More modern *in vitro* methods will be necessary if it is needed to identify

radiation types that minimize biological impacts on OXPHOS. In this context, *in vitro* investigation of OXPHOS mechanisms may be productive as there are plenty of molecular tools available to investigate this metabolic pathway.

MITIGATION

Attenuating EMR health impacts for ELF power systems or RF wireless should not slow down technological developments, but steer engineering towards maximally health-compatible directions.

Reductions in EMR exposures should be implemented over time as quantifiable impacts on disease rates are documented. Because engineering is flexible, it is expected that the fiscal gains from disease rate reductions in terms of a healthier population will be much higher than any long-term costs of exposure mitigation.

STRATEGY

Industry (power and telecommunications) should be involved in reducing the costs of health investigations primarily by contributing exposure data. For most industry audiences, the statistical deliberations of epidemiology may be a bridge too far. The skills of engineers could however be recruited to fully document the exposures considered to be central to the triggering of health impacts.

As the engineering community must be recruited, science arguments will be more palatable to this audience than the statistical deliberations of epidemiology.



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