Health Matters

Follow-Up Research on NTP's Clear Evidence on RF Causing Malignant Tumors in Rats

■ **James C. Lin**

The recent disclosure of the U.S. National Toxicology Program (NTP) closing down its RF radiation research program on how RF radiation causes cancer was a surprise [1], [2], [3]. NTP is a part of the National Institutes of Health and reports to the U.S. Department of Health and Human Services. NTP's mandates are to provide the scientific basis for programs, activities, and policies that promote health or lead to the prevention of disease.

NTP's motto is "science you can depend on for decisions that matter." It is a world leader in toxicology research. It has evaluated more than 2,800 environmental agents for potential human health effects. It plays a critical role in generating, assessing, and sharing toxicological information about potentially hazardous agents in the environment. Its latest congressionally mandated, science-based public health document, the 15th Report on Carcinogens [4], was released on 21 December 2021. An article published in the December 2023 issue of the journal *Environmental Health Perspectives* [5] included an interactive tool that demonstrates the Report on Carcinogens' impact on public health policies.

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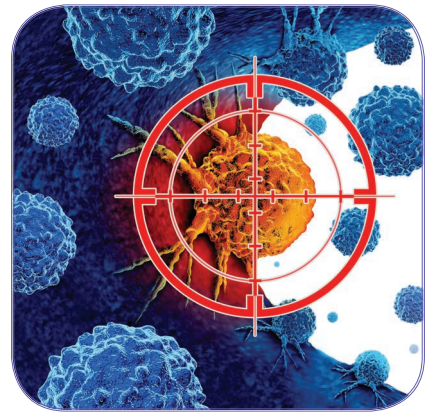

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In 2018, NTP published the final report on its US$30 million laboratory research showing "clear evidence" that lifelong exposure to low-level RF radiation caused cancers in rats [6], [7], [8]. The statistically significant findings showed that both GSM- and CDMA-modulated 900-MHz RF radiation had led to the development of malignant schwannoma, a rare form of tumor in the hearts of male rats. Furthermore, an independent analysis of the NTP data for overall cancer incidence detected in any organ or tissue inside the animal showed that rats exposed to GSM and CDMA cellphone RF radiation had significantly higher overall or total primary tumor incidence than the concurrent controls.

The NTP research is the largest and most comprehensive study, to date, of health effects in animals exposed to RF radiation. The U.S. Food and Drug Administration nominated RF radiation for study by the NTP in 1999. The rationale was the widespread human exposure and limited information about the potential health effects of long-term cellphone use. The study used NTP's scale of evidence rating for cancer studies. The scale ranges from the highest rating of "clear evidence," followed by "some evidence," then "equivocal evidence," and finally "no evidence." Different organs or tissues can have different conclusions.

Since then, there have been two follow-up projects as efforts to either confirm or extend the NTP results.

One follow-up study is the Japan and Korea collaboration in a confirmation or partial replication of the NTP

animal study on cancer risks from cellphone RF radiation [9]. The NTP findings of clear evidence that RF radiation can cause cancer was already reaffirmed by the Ramazzini Institute study from Italy [10]. The new project is a scaled-down version with a single exposure parameter at an SAR of 4 W/kg in contrast to NTP's whole-body SARs of 1.5, 3.0, or 6.0 W/kg. The coordinated project involving laboratories from two different countries employed the same custom-designed RF exposure system (reverberation chamber [RC]) and applied the same study protocol with Sprague-Dawley rats from the same breeder. The experimental animals were not restrained in order to avoid the well-known stress from such practices that could potentially confound the results.

An important performance feature for an RC is the electrical field uniformity. In this case, it was evaluated at 900 MHz using 150 measurements taken at 150 points in an empty chamber and a loaded chamber with 80 live rats (mean body mass of 330 and 470 g). The conditions of the loaded chamber with the rats mimicked the actual experimental environment where the rats, watering systems, animal bedding, cages, and cage racks were all in place. The measured electric field uniformity was within 1.0 dB and 2.3 dB under the empty and the rat-loaded conditions, respectively.

The exposure of experimental animals to 900 MHz RF radiation in the Japan and Korea collaboration commenced in November 2020, and the two-year in vivo exposure phase was completed in December 2022, independently in Japan and Korea. The histopathological evaluation is currently underway, and formal publication of the results will likely need to wait another year from now, if not later.

In 2019, NTP announced a new genotoxicology project designed to examine how RF radiation causes cancer. The wide-ranging study plan included DNA damage and repair, gene expression, and oxidative stress, as well as the possible impacts on behavior and stress. It was understood at the time that the new mechanism study would use a small number of more compact exposure chambers with similar RF field characteristics but without involvement of the large reverberation chambers used for the prior NTP study. The smaller chambers were designed and manufactured by the same company. They were being tested and would be ready soon for the feasibility phase of in vivo rodent studies.

Apparently, now, close to five years later, the new project has never progressed beyond the feasibility studies with the compact exposure chambers. Moreover, the NTP located in Research Triangle Park, NC, USA, no longer plans to study biological effects from cellphone RF radiation. NTP has decided that "the research was technically challenging and more resource-intensive than expected." This effectively marks the end of the

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nonmilitary governmental project in the United States to study the biological effects of cellphone or RF radiation. Any future NTP publications on the topic would come from the feasibility studies only [3].

Unfortunately, whether the U.S. civilian government halts doing the important research on mechanistic causes for cancer from low-level chronic exposure to RF radiation or not, nearly 100% of all Americans are being cast as subjects in a massive health experiment without a formal protocol. Furthermore, billions of people worldwide, including the young and older adults, are being exposed to unnecessary levels of human-made wireless RF radiation.

The obvious question is, what happened? Should we all forget about NTP's findings of clear scientific evidence that lifelong exposure to low-level RF radiation causes cancer from a federal government health agency that prides itself in telling the nation that its product is "science you can depend on for decisions that matter"?

Postscript

It is interesting to recall that the recently announced termination of NTP's RF research program on how RF radiation causes cancer practically halts most, if not all, biological research of RF radiation supported by the civilian U.S. government. In contrast, the military arm of the U.S. government through its Defense Advanced Research Projects Agency (DARPA) has initiated a new research program on the roles RF radiation may have in biological systems [11]. DARPA's historical and contemporary contributions to scientific and technological advancements are widely known. Thus, it poses the question, what does DARPA know about RF radiation on biological systems?

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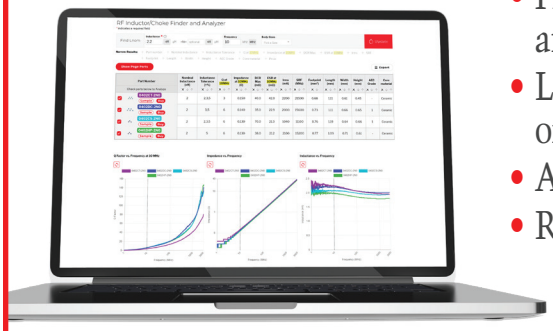

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