

# Radiofrequency (RF) Sickness in the Lilienfeld Study: An Effect of Modulated Microwaves?

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**ABSTRACT.** There is a controversy among professionals regarding whether radiofrequency radiation sickness syndrome is a medical entity. In this study, this controversy was evaluated with a methodology adapted from case studies. The author reviewed U.S. literature, which revealed that research results are sufficiently consistent to warrant further inquiry. A review of statistically significant health effects noted in the Lilienfeld Study provided evidence that the disregarded health conditions match the cluster attributed to the radiofrequency sickness syndrome, thus establishing a possible correlation between health effects and chronic exposure to low-intensity, modulated microwave radiation. The author discusses these health effects relative to (a) exposure parameters recorded at the U.S. Embassy in Moscow and (b) the Soviet 10-microwatt safety standard for the public. Given the evidence, new research—with current knowledge and technology—is proposed.

## Literature Review of Human Studies

THE RADIOFREQUENCY RADIATION (RF) SICKNESS SYNDROME is a controversial medical entity in the United States. It is a systemic human response to chronic low-intensity RF exposure, identified in the 1950s by Soviet medical researchers,<sup>1</sup> who named it *neurotic syndrome*. Some of the symptoms are headache, ocular dysfunction, fatigue, dizziness, and sleep disorders.<sup>2</sup> In the United States, professionals have largely dismissed reports about this syndrome, citing it as being subjective and indicating that it results from an awareness bias; nonetheless, RF sickness syndrome has been legally recognized as "microwave radiation sickness."<sup>3</sup> Only in Soviet medicine<sup>1-4</sup> are the following clinical manifestations accepted: dermatographism, tumors, hematological alterations, reproductive and cardiovascular abnormalities, depression, irritability, and memory impairment (among others). In 1978, Justesen et al.<sup>3</sup> recognized that Soviet research had "ecological validity," but they did not endorse the safety standard for the public (i.e., 10 microwatts [mW]). In Mitchell's 1985 review,<sup>4</sup> he confirmed that Soviet researchers considered the existence of

neurological manifestations to be proven. In the United States, professionals simply dismissed the syndrome.

The available literature in the United States contains information in support of the RF sickness syndrome as a medical entity. Occupational studies<sup>1,2,7-11,17</sup> conducted between 1953 and 1991 and clinical cases<sup>12-15</sup> of acute exposure between 1957 and 1993 offer substantive evidence for the syndrome. Soviet researchers contend that the syndrome is reversible at early stages, but maintain that it is lethal over time.<sup>16</sup> The most valid criticism is the lack of study results that provide accurate exposure parameters linking cause and effect.

## Radiofrequency Radiation Sickness in the Lilienfeld Study

The Johns Hopkins Foreign Service Health Status Study<sup>17,18</sup> (i.e., Lilienfeld Study) contains both medical data and properly recorded exposure parameters. To date, however, investigators have not evaluated the data, relative to RF sickness syndrome. Investigators conducted the Lilienfeld Study during the period of irra-

diation between 1953 and 1976 in response to the microwave irradiation of the U.S. Embassy in Moscow.

In the literature published in the United States, investigators acknowledged that elevated lymphocyte counts and protozoan intestinal diseases were the only statistically significant illnesses that occurred in Moscow Embassy personnel (versus controls). In the study investigators concluded that, at the time of analyses, there was no convincing evidence that directly implicated exposure to microwave irradiation in the causation of any adverse health effects.

It should be noted, however, that in the Lilienfeld Study, other higher and statistically significant effects, relative to controls, were not accounted for.<sup>18</sup> Four of the effects are clinical manifestations that the Soviets have attributed to RF sickness: (1) dermatographism (i.e., psoriasis, eczema, and inflammatory and allergic skin problems); (2) neurological (i.e., diseases of the peripheral nerves and ganglia among males); (3) reproductive (i.e., problems during pregnancy, childbirth, and puerperium); and (4) tumors (benign among men, malignant among women). Other reviews of the Lilienfeld Study have contained information about additional hematological changes that occurred among the embassy personnel.<sup>9,19</sup> Three of the effects are mood alterations attributed to the syndrome: (1) irritability; (2) depression; and (3) loss of appetite. Two are functional deficits also attributed to the syndrome: (1) concentration difficulties and (2) refractive eye problems. The results of past and current research<sup>20,21</sup> have verified neurological effects resulting from microwaves that the Soviets attributed to the syndrome. All of these confirm the presence of RF sickness syndrome.

The recorded<sup>18-22</sup> exposure parameters were continuous-wave, broad-band, modulated microwave RF radiation. The frequency range was between 0.6 and 9.5 GHz. Exposures occurred 6-8 h/d, 5 d/wk. Each modulation (i.e., phase, amplitude, and pulse) was transmitted for only 48 h (or less) at a time. The average exposure per individual was 2-4 y. The intensity range was between 0.002 and 0.028 mW/cm<sup>2</sup>. Intensities were 1 000 times below the safety guidelines proposed in the United States,<sup>8</sup> but the range met Soviet safety standards for the public—a fact that shifts attention to the properties of the exposure parameters.

The best match for the parameters<sup>23-25</sup> is given by the Soviet remote-sensing radar system for medical applications, described by Lin.<sup>23</sup> The exposures recorded at the U.S. Embassy were within the ranges of those produced by this radar system. Average power densities between 1 mW/cm<sup>2</sup> and 1 milliwatt/cm<sup>2</sup> were sufficient for the remote recording of physiological data. Given that Soviet physicians were instrumental in setting the 10-mW standard,<sup>9</sup> an implicit knowledge is evinced: the modulations capable of eliciting biosignals<sup>26</sup> from specific biological sites have key significance. Thus, we can propose both (a) that significant adverse health and behavior effects, like those found in the Lilienfeld Study, can be attributed to chronic exposure to low-intensity, appropriately modulated microwave radiation; and (b) that such a link can be verified empirically. In 1995, the

U.S. Environmental Protection Agency and the National Council on Radiation Protection stated the need to formally address the health hazards of modulated RF radiation.<sup>27</sup>

## Conclusion

The evidence from the literature review, as well as from the Lilienfeld Study, support the RF sickness syndrome as a medical entity. The evidence also calls for new research in which current biomedical engineering knowledge of biosignal processing and instrumentation are used.

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