

Dosimetric Extrapolation — Interpreting Bioeffects Data Obtained from Small Biological Subjects to Predict the “Biologically Effective Dose” in Humans

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The biological effects of exposure to electromagnetic fields are usually studied by exposing small animals to increasing levels of *external* radiofrequency (RF) fields. This is performed to determine the “biologically effective” dose rate. This dose rate represents the lowest level of *internal* power density that reliably elicits a particular biological effect. Specific Absorption Rate (SAR) is the most commonly used dosimetric parameter and is expressed in units of Watts/kg. It is equivalent to the rate of absorbed energy density in a given volume of the subject's body. This paper examines the most appropriate means for carrying out “dosimetric extrapolation.” This extrapolation process allows the prediction of the external (exposure) field strengths that would induce a “biologically-effective dose rate” in humans. This dose rate is equal to the value that induced a specific bioeffect in laboratory animals.

Most contemporary RF protection standards specify a maximum permissible external exposure (power density or electric- and/or magnetic-field strengths.) A majority of these exposure limits were determined using a dosimetric extrapolation process based on the *whole-body-average* SAR that induced an effect in animal experiments. The SAR data was then used to estimate the external plane-wave field strengths or plane-wave power densities that would induce the same whole-body-average SAR in the human body. This was done over a wide range of frequencies. Then a safety margin was used to define exposure limits.

This paper presents a method of dosimetric extrapolation that is applied to a variety of “organ-specific” biological effects, such as stun and evoked body movement. These particular effects are induced by a brief burst of selective exposures of the head and neck region of laboratory rodents. Human dosimetric data for the brain region from several published studies of a standing adult human are then used to predict the magnitude of whole-body, plane-wave exposures that would induce a biologically effective dose in the human brain over the frequency range of 20 to 915 MHz.

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