

Why “measurand” is the first scientific word we should teach health physicists

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The word “measurand” means “the quantity intended to be measured.” The authors argue that health physicists should distinguish between measurands and measurement results because the former exist in the domain of theory, while the latter exist in the domain of reality in which we make measurements and observations. The authors demonstrate the importance of separating the quantities used in theory and those used in experiment, clearing up conceptual confusions in three examples of problems routinely encountered in health physics: (1) detection and quantification of radioactive material; (2) multiple definitions of “activity,” and (3) the relationship between radiation and health effects. The first example looks into probabilities of various measurement results (m_i) given the measurand (μ) in comparison with the inverse problem: determining probable values of the measurand (μ) based on observed measurement results (m_i). The second example addresses the distinction between measurands and measurement results given two definitions of activity A provided by the International Commission on Radiation Units and Measurements. Additional consideration is given to use of $N + 1$ counts in (activity) calculations when we have observed N counts, which results from correctly stating and solving the inverse problem. This makes our measurement uncertainties more accurate and our detection decisions more reliable. The last example emphasizes how the observational results of epidemiology, animal experiments, and other radiation biology studies are used to estimate the probability of a particular cancer in an individual—a measurand that is not otherwise accessible to direct observation. Our measurement results, and our use of those results, are more easily understood when we understand the difference between a measurand and a measurement result and can choose the best calculational approach.

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