Attributability of Health Effects at Low Radiation Doses

González, A.J.

Presentado en: 12th International Congress of the International Radiation Protection Association.
Buenos Aires, Argentina, 19-24 octubre 2008.
El presente trabajo se presentó oralmente durante el evento.

ATTRIBUTABILITY OF HEALTH EFFECTS AT LOW RADIATION DOSES

Abel J. González

Autoridad Regulatoria Nuclear, Av del Libertador 8250, 1429,
Buenos Aires, Argentina

agonzalez@sede.arn.gov.ar

Abstract

A controversy still persists on whether health effects can be alleged from radiation exposure situations involving low radiation doses (e.g. below the international dose limits for the public). Arguments have evolved around the validity of the dose-response representation that is internationally used for radiation protection purposes, namely the so-called linear-non-threshold (LNT) model. The debate has been masked by the intrinsic randomness of radiation interaction at the cellular level and also by gaps in the relevant scientific knowledge on the development and expression of health effects.

There has also been a vague use, abuse, and misuse of radiation-related risk concepts and quantities and their associated uncertainties. As a result, there is some ambiguity in the interpretation of the phenomena and a general lack of awareness of the implications for a number of risk-causation qualities, namely its attributes and characteristics.

In particular, the LNT model has been used not only for protection purposes but also for blindly attributing actual effects to specific exposure situations. The latter has been discouraged as being a misuse of the model, but the supposed incorrectness has not been clearly proven.

The paper will endeavour to demonstrate unambiguously the following thesis in relation to **health effects due to low radiation doses**:

(i) **Their existence is highly *plausible***. A number of epidemiological statistical assessments of sufficiently large exposed populations show that, under certain conditions, the prevalence of the effects increases with dose. From these assessments, it can be hypothesized that the occurrence of the effects at any dose, however small, appears decidedly worthy of belief. While strictly the evidence does not allow to conclude that a threshold dose level does not exist either In fact, a formal quantitative uncertainty analysis, combining the different uncertain components of estimated radiation-related risk, with and without allowing for the uncertain possibility of a universal low-dose threshold, concludes that the evidence does not favour the existence of such a universal threshold. Consequently, radiation protection measures ought to be applied to radiation exposure situations involving low radiation doses.

(ii) **They are *improvable* at individual level.** The effect occurrence on specific individuals is not demonstrable on a yes-no basis. Its reality is axiomatic: namely taken by granted as self-evident, solely based on the acceptance of the LNT hypothesis as the only true basis for argument or inference. It is unfeasible to demonstrate the existence of the effects by uncontestable evidence: the truth, validity, or genuineness of their diagnosis for specific individuals cannot be tested and the diagnostic correctness cannot be checked.

(iii) **Their individual causation is *counterfactual***. The proposition ‘a radiation exposure situation caused a health effect on an individual’ cannot be explained in terms of the counterfactual conditional ´if the radiation exposure situation had not occurred, then the health effect would not have occurred´.

(iv) **Their occurrence is not individually *attestable*.** In addition to their improvability, any formal proof of the existence of a radiation health effect on any specific individual is generally absent and impossible to obtain at low radiation doses and cannot be established through scientific evidence.

The papers winds up that ***attributability,*** namely the assumption that some health effect occurs as the result of a given low-dose radiation exposure situation, are distinct notions at the collective and individual level. It then concludes the following:

- Increases in the effect (collective) prevalence can be *attributable* in the sense that the radiological impact on a population can, under certain conditions, be ascribed, namely credited, assigned, and imputed to a specific exposure situation as its cause or source. Attributability is only conditional on the assumption that the relationship between the number of people being exposed and their doses is robust enough to make epidemiological attestability feasible (Strictly, the population would also need to be identical to those populations studied epidemiologically).
- Conversely, at the individual level, stochastic health effects at low doses are, at this time of biological understanding, unfeasible to be credited, assigned and imputed and consequently ascribed to a specific exposure situation;
- However, if attributability is taken to be a stochastic notion, then a conditional probability of causation can be theoretically assigned (following Bayes’ theorem and using available scientific information). This stochastic attributability, nevertheless, will not be attestable.
- Therefore, while individual health effects can under certain theoretical assumptions be stochastically attributable, they can not be subjected to an attestable attributability.
- As a result, presently individual health effects can not be deterministically attributable to radiation exposure situations delivering low radiation doses and, thus, they may not be deemed attributable in codified legal systems.

.

KEYWORDS: Attributability; Low Radiation Doses.