What Radiation Exposure Standards Mean

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Although nearly ten months have passed since the Great East Japan Earthquake, the ensuing “radiation panic” seems to be growing more serious by the day, instead of calming down. We see a tearful academic professional speaking out on the dangers, and a physician just emphasizing safety. In short, we find the positions of experts divided, while the “common knowledge” of the vested interests enveloping the nation’s nuclear power plants has made many of people skeptical of the opinions of these experts. Meanwhile, I have haplessly been labeled the “official’s scientist,” despite having no connections to TEPCO (the Tokyo Electric Power Company) or the Japanese Government. But the question remains: Why is expert opinion so divided over the effects of radiation exposure?

Much of the confusion relates to the mistake of equating risk “assessment” with risk “management”. Risk assessment is based on scientific evidence; on the other hand, risk management guides policy that sets forth an approach to radiological protection. For example, the statement, “At 100 millisieverts(mSv) or less, no evidence of cause and effect between radiation exposure and manifestation of cancer has been confirmed,” is science. Upon obtaining international consensus, UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) becomes the institution that announces scientific evidence (hypothesis) in this domain. For instance, a report would state, “Epidemiologically speaking, no impact from radiation of 100 mSv or less is recognized.”

Yet from a risk management perspective, the ICRP (International Commission on Radiological Protection) takes the matter-of-course position that radiation exposure should be as minimal as possible. The grounds for the ICRP issuing its recommendations, nevertheless, are the science proscribed by UNSCEAR above. Thus, as the premise to its policy, the ICRP takes the scientific impact of radiation recognized by UNSCEAR, which states that at over 100 mSv the risk of cancer increases linearly in proportion to the dosage of radiation exposure and at 100 mSv or less no epidemiological impact is recognized. But the policy has taken the linear relationship between dosage and impact for the graph plotted above 100 mSv, and extended this line below 100 mSv to create a system of radiological protection. This action is based on protection philosophy to address safety issues.

Based on this policy, the ICRP recommends, under ordinary conditions, an annual limit of radiation exposure to be 1 mSv for the general public and 50 mSv for occupational duty, or no more than 100 mSv over 5 years for the latter (emergencies such as the recent Fukushima incident are a separate matter). The ICRP has also recommended 20 to 100 mSv annually in an emergency when radiation exposure cannot be controlled, a target to be established between 1 to 20 mSv annually thereafter under some recovery of control, and a return to ordinary conditions (1 mSv　annually) in the end. All of these figures are merely protective policy established under the risk assessment (the scientific basis, not risk management) that has not recognized any scientific impact below 100 mSv. So the risk assessment remains unchanged, but the behavior toward the risk (risk management) necessarily changes according to the circumstances.

There are additional concerns being voiced, such as, “Why is the worker permitted an exposure level several ten times more than the general public?” and “Isn’t it odd that greater exposure is allowed in an emergency than under ordinary conditions for the same person?” Actually, the recommended levels “change,” because they inherently represent protection guidance (risk

management), rather than scientific data (risk assessment).

Scientific risk assessment of radiation and guidance (risk management) for protection based on such assessment should not be confused. Certainly, the annual limit of radiation exposure at 1 mSv under ICRP recommendation has been adopted by Japan's Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others in a similar fashion as many other countries. But let us remember that the statutory annual limit of 1 mSv has no scientific basis; it is simply a protective guideline with a sufficient perimeter of safety. Otherwise, if we become obsessed with applying a guideline under ordinary conditions to an emergency, we will instead face additional health hazards—such hazards that were quite prominent in Chernobyl.

The Linear No-Threshold (LNT) model widely circulated throughout the general populace since the accident at Fukushima Dai-Ichi Nuclear Power Plant relates to the protection policy that the ICRP has issued on the basis of its philosophy on safety, and is not pointing at scientific data. Yet the model has taken a combined form of risk assessment and risk management.

For instance, the resulting graph shows risk increasing positively from the origin for a dose-carcinogenesis correlation, and is creating a lot of misunderstanding. UNSCEAR reports scientific data, and the ICRP recommends guidelines for risk management based on this data. This relationship should be understood better. We see "experts" debating over just the LNT model without recognizing this relationship. A typical misapplication in the debate would be the remark, "An extra 2 millisieverts in dosage means an additional 200 people succumbing to cancer among the 2 million residents of Fukushima Prefecture." In fact, the ICRP itself clearly states that the LNT model should not be used in such calculations, as follows:

"The effective dose should be used neither to retroactively assess the risk of probabilistic impact for the radiation exposure of a specific individual, nor to epidemiologically assess radiation exposure of humans." [1] The simple fact is this: No genuine expert believes that the incidence of cancer will increase from the added exposure of several mSv.

The lack of distinction between risk assessment and risk management leads to confusion between science (scientific evidence, scientific hypothesis) and philosophy (safety philosophy and policy of radiological protection). The theories set forth by the "experts" are laden with a heavy responsibility in causing massive confusion among our society and the consequential reduction in longevity of all Japanese.

References:

[1] ICRP Publication 103 P13 (K)