



Navigating Fukushima: Lessons from Chernobyl, Potential Radiation Effects, and Other Health Impacts

An Interview with Dr. Scott Davis

By Rebecca Kennedy

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The evolving nuclear crisis in Fukushima will create long-term challenges for both Japan and the world. This week, which marks the 25th anniversary of the Chernobyl disaster, we spoke with Dr. Scott Davis, an expert on the measurement and the effects of radiation exposure, about the mechanics of the disaster, how it compares to Chernobyl, and the crucial health concerns. This interview was published on the NBR website: <http://www.nbr.org>.

Dr. Davis is Professor and Chairman of the Department of Epidemiology in the School of Public Health at the University of Washington, and a Full Member in the Epidemiology Program of the Public Health Sciences Division at the Fred Hutchinson Cancer Research Center. His work focuses primarily on radiation epidemiology. For more than ten years, Dr. Davis has overseen two major research projects investigating the effects of radiation exposure on human health—at the Chernobyl Power Station and the Hanford Nuclear Site in eastern Washington State. Dr. Davis also served as director of a joint partnership between his affiliate institutions and the Radiation Effects Research Foundation (RERF) in Hiroshima, Japan. He is currently a consultant to RERF.

Japan elevated its assessment of the Fukushima Daiichi nuclear plant crisis to the International Atomic Energy Agency's highest rating of Level 7. This decision, in effect, equates the Fukushima crisis with the Chernobyl disaster. Can you make some broad comparisons between the events?

The events at Chernobyl and Fukushima are similar in that they both involved power-generating units—these units both lost cooling water, which eventually led to exposure of the reactor core and rapid overheating. In the case of Chernobyl, this resulted in a huge steam explosion that destroyed not only the reactor and exposed its core, but also the outer containment building itself as well.

Although there were evidently explosions at the Fukushima site, they have *not* done the type of damage seen at Chernobyl. Most importantly, the containment building has not been destroyed, nor has the reactor core been damaged to the degree it was at Chernobyl. Thus, the quantity of radioactive material released into the atmosphere at Chernobyl was substantially greater than what has happened thus far at Fukushima.

To date, the amount of radioactive material released at Fukushima has been estimated at about 10% of the output at Chernobyl. Although considerably less than Chernobyl, as you noted, many Japanese have nonetheless been exposed to various levels of radiation. What possible health consequences may we expect, both for those near the nuclear plant, and others further afield, such as in Tokyo?

The physical effects really depend on the dose of radiation received, and in many instances, the age of the individual at the time of exposure. We still don't know what the doses will be and, of course, they will vary depending on a number of factors.

My understanding from media reports *only* is that much of what was released and that has dispersed is radioactive iodine, also known as I-131. If these reports are true, the most likely effect will be thyroid diseases and thyroid cancer—particularly in people who were young children or infants at the time of exposure. Fortunately, I-131 has a relatively short half-life, a little over eight days, so it is essentially gone in a matter of several weeks.

Exposure may also lead to greater chances of various forms of cancer, including leukemia, and many years later, perhaps breast cancer and tumors in areas such as the lungs, colon, esophagus, or ovaries.

How much do varying personal factors such as proximity to the radiation release, the source of the contamination, or pre-existing health conditions, matter?

There are no “hard and fast” rules that apply to all people or all events. Thus, the physical health risks depend entirely on the dose of radiation received, as well as *how* it was received—whether it was external versus internal, and over what period of time (that is, the dose rate).

The dose of radiation that a person receives depends on a wide range of factors—these can include the exposure pathway, that is, if the contamination occurred via surface, food, or air. Also, the matter of acute or chronic exposure and a given individual's pre-existing health conditions come into play. A classic example is the combination of smoking, radiation, and lung cancer. The pre-existing condition in this example isn't a disease, but rather an exposure. The joint effects of smoking and radiation on lung cancer risk are *far* greater than either condition by itself.

One group especially at risk due to personal circumstance is the workers at the Fukushima plant, who have received higher doses of radiation than considered safe for optimal health. Although little concrete information is available on what they are enduring, it may help us better understand the situation if you can describe some preventive and protective measures generally taken in occupational environments that feature radiation.

People who work with or around radiation are some of the most carefully monitored and protected in the workforce. Strict limits are set regarding the amount of radiation to which a worker can be exposed per a given unit of time, such as by day, week, or month.

Occupational exposure to radiation is tightly regulated. Exposures are typically very low, and it takes time to accumulate enough doses to reach the limit. This might be very different in a situation like Fukushima, where the yearly dose limit might be reached in a matter of minutes for workers directly involved in rescue operations or trying to deal with the accident. They would need to be removed from the site and another worker would have to take his/her place.

The primary physical defense is a sealed protective suit with a respirator system. Certainly, as much education as possible regarding the situation at hand is also always important. If much of the radiation is due to radioactive iodine, one might consider taking potassium iodide pills, but that tactic is more helpful for children or infants.

You have discussed the possible physical health effects of the Fukushima crisis, including for the general public and the nuclear plant personnel. What are your thoughts on the mental health implications?

The mental effects are likely to be substantial, especially given the classification of the Fukushima situation as a Level 7 event, because the effects on one's mental health are largely governed by one's perceived danger. It has often been said that the greatest toll from Chernobyl has been psychological, not physical. Unfortunately, there has been very little investigated along those lines at Chernobyl. I would hope there will be a more systematic approach developed and implemented to formally study these possible effects at Fukushima. It is, however, a very difficult area to study.

How can the findings of the Chernobyl disaster inform Japan's management of the Fukushima situation?

The primary lesson that Chernobyl has taught us in terms of planning and conducting long-term follow-up is *the importance of beginning immediately*. Many of the larger efforts to study the aftermath of Chernobyl were severely challenged because several years had gone by since the accident. A significantly late start makes all aspects of conducting a study even more difficult than it already is—it is far more difficult to identify persons for study, to trace and locate them, to get them to enroll, to identify and review their medical records, and to estimate an individual radiation dose, after a significant amount of time has elapsed.

As the Fukushima disaster is still relatively recent, do you then see the Japanese as particularly well-positioned to establish a successful radiation monitoring program? How might tracking the effects in Japan compare to Chernobyl?

I think the Japanese are quite well-suited to establishing a long-term follow-up program. They have an infrastructure that would support such an effort, they have people with the needed expertise, and they most likely have the financial resources to pay for it. None of those factors were present at the time of the Chernobyl accident, in what was then still the Soviet Union.

I believe that given their experience with atomic bomb survivors and the strong support mechanisms in place, the Japanese are particularly capable and prepared for the difficult task of tracking the effects of radiation exposure.

Rebecca Kennedy is Editing Intern for the NBR Center for Health and Aging and leading the Center's Expert Q&A's on the health implications for Japan following the earthquake and tsunami of March 11, 2011.