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Commentary on the Combined Disaster in Japan[1]

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The report by Dr. Takeo Ohnishi in this issue of *Radiation Research* (1) is a comprehensive detailing of the Fukushima-Daiichi nuclear power plant (NPP) disaster. We have chosen for the title of this commentary "combined disaster," which is emphasized by both Dr. Ohnishi and Dr. Makoto Akashi from the National Institute of Radiological Sciences (2), who was involved in the management of the incident. Dr. Akashi and others emphasize the catastrophic loss of life and damage primarily from the earthquake and tsunami and that the NPP disaster was the consequence of the loss of infrastructure, including power supply and access to the facility. There are lessons observed regarding NPP issues, and there is now broad worldwide discussion on the future of energy sources. The consequences of the NPP disaster will take years to better understand as the Fukushima-Daiichi incident plays out. In addition, nuclear power issues will take decades to be addressed, given the complexity of worldwide energy needs, potential sources and suppliers of alternative forms of energy, and the environmental impact of the rising worldwide energy demand. Furthermore, energy policy complicates matters as decisions by one country can have an enormous impact on its neighbors and the entire world.

This commentary is from the personal and professional perspective of the four coauthors, who were directly involved in the response at the U.S. Embassy in Japan (CNC and MAN) and in the U.S. at the National Security Staff (CBM) at the White House and Centers for Disease Control and Prevention (RCW). In that the number of radiation experts within the U.S. government (USG) is small and there are many ongoing interagency collaborations [e.g., Planning Guidance (3)], the overall U.S. response involved people who worked tirelessly over the first month to provide their expertise and support for the international and domestic aspects of the response, including supporting the Japanese. This NPP disaster is unique in the enormity of the overall infrastructure damage, the sophisticated response and monitoring ability, the breadth of the media attention, the presence of multiple potential sources for radiation release, and the stepwise evolution with real-time monitoring of an environmental radionuclide release. While comparisons are made with Chernobyl, this

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incident was certainly different in terms of the type of reactor, character of radionuclide release, and timeliness of reporting in regard to the onset of the incident (2).

As Dr. Ohnishi summarizes, the Japanese conducted a very effective evacuation, which is particularly remarkable given all the physical and social infrastructure damage and loss of life. There was great uncertainty as to the status of the nuclear reactors due to lack of access to the facilities. The collaborative efforts between the U.S. Department of Energy, Nuclear Regulatory Commission and Department of Defense illustrated the importance of the U.S. partnership with Japan and the capabilities that the U.S. possesses to respond to catastrophes, including radiological and nuclear incidents.

It is our perspective that the initial focus for any disaster is on the health and medical consequences. In that regard, expertise on all aspects of the health and medical consequences is needed, and this requires an ability of experts to function in a disaster mode. Early speculation from a variety of sources led to panic buying of potassium iodide in the U.S. The early lack of data and information, clearly an issue with the huge infrastructure damage and complex multi-reactor scenario, led to both a loss in “credibility” in public officials and the filling in of the information void with speculation, opinion and misinformation.

The response of the various foreign governments for their people living, working and traveling in Japan varied. Some embassies evacuated staff from Tokyo to other sites in Japan and also provided support for voluntary departures from Japan. This was not just due to the radiation, although that was certainly a component; it was also based on the complexity of ongoing aftershocks, decrement in power supply, and concern for other aspects of infrastructure shortages such as food and transportation. Furthermore, as the disaster unfolded, concern by families for safety of children and pregnant women and the enormous and near round-the-clock effort required by those working in Tokyo simply made having the family elsewhere the logical choice. As we saw it, the superb response by the U.S. embassy in Tokyo is credit to the dedication of the staff and the flexibility for people to take on tasks well beyond their routine. Under very difficult circumstances, the leadership gathered information, listened to the issues of concern, truly comprehended the depth and complexity of the issues facing the Japanese and the U.S. citizens in Japan, and recognized the critical need to steer a course based on the best available data and information.

While much of what follows sounds obvious, the obvious does not always happen. There is an enormous fear of radiation because it cannot be seen, heard, felt or smelled. What is in some ways reassuring is that it can be measured, but the ability to measure minute quantities presents a problem of how to communicate risk in an understandable way. In Japan, our task was to try to understand who and what was at risk from radiation. This required reasonable projections based on what data on radiation levels were available and from weather predictions. That the risk to the general public of doses high enough to produce the acute radiation syndrome (ARS) was miniscule was a key point in that the public does not distinguish deterministic from stochastic effects. We had to deal with commentators describing the impact of atomic-bomb-like doses including ARS and fetal effects. With the prompt evacuation of the area surrounding the NPP, there was essentially no risk of ARS for

anyone but possibly those on site. As Dr. Ohnishi describes, there were no cases of ARS. While providing accurate information was important, what was perhaps more important was the availability of credible expertise on scene. What one of us (CNC) found out in a return visit in September when speaking to friends made in the American Chamber of Commerce in Japan was that even more important than the expertise was that fact that I was actually there in Tokyo.

Understanding radiation risk is difficult for experts and many times more so for non-experts. The team sent to Japan under the support of the Assistant Secretary for Preparedness and Response in HHS (Dr. Nicole Lurie) was a five-member team including experts in radiation dosimetry (Dr. Steve Simon, NCI), food and water issues (MAN), risk communication (Jana Telfer, CDC), and medical countermeasure logistics (Tom Bowman, CDC) (4). Communication is a challenge and involves nuance of language and cultural issues in addition to knowing how to best use the various types of media. The major issue once the acute phase ebbed and the extent of the impact was better known was how to begin to back off from the warnings, restrictions and interdiction of food, water and goods. The health and medical consequences beyond the impact of the radionuclide release depend on the resilience of the community and a return toward a “new normal.” Stress-related illness will far outweigh any direct medical consequence from the radiation, an issue well recognized from Chernobyl (5) and by the Japanese as indicated by Dr. Ohnishi and also from the International Expert meeting in Fukushima (2) in September.

The breadth of what is now included in the term “media” and the competition for viewers lend themselves to hyperbole. Interesting is how rapidly attention from one disaster or incident is almost completely displaced by the next one. The early media attention and somewhat sensational reporting ended abruptly, particularly as the crisis in Libya escalated. This reduction in interest did not allow the good-news aspects of the incident and the ebbing of radiation risk to be covered so that people may have been left with the impression of an ongoing catastrophe that was beginning to be contained.

Dr. Ohnishi’s article identifies several long-term tasks facing Japan’s public health and medical system in recovering from the Fukushima radiological releases that contaminated people, places and products. These long term tasks include: “more detailed dosimetry studies; decontamination and transfer of radioisotope-contaminated materials; return all of the evacuees to their hometowns and villages; and healthcare and monitoring of the public in Fukushima prefecture and radiation workers in the plant over the long term.”

Japan’s public health and medical systems were also facing enormous monitoring and communications challenges during the period when radioactive material releases were occurring. As the radioactive airborne plume moved across the Pacific Ocean from Japan, trace levels of radioactivity were detected in the U.S. states and in other countries. Japan’s global health partners were actively monitoring for traces of radioactive materials in air, food and water and moving quickly and effectively to protect public health. In addition, returning travelers and cargo were monitored at international ports of entry for potential contamination. All this monitoring activity was also accompanied by an extensive and

timely guidance and communications message development and dissemination activity by countries to inform their citizens in Japan and within their borders about levels found.

As the country of Japan moves forward with the recovery and the planned 30-year health monitoring program for the people residing in the Fukushima Prefecture, decisions will need to be made about who was exposed or contaminated, what is a level of public health concern, and how to communicate this effectively. It is a challenging task but one we anticipate that the nation of Japan will accomplish through their strong self-reliance, determination and unwavering desire to return to a sense of normalcy. The global public health community will continue to support our Japan colleagues and strive to learn from this experience and apply those lessons as we plan to respond to and recover from any radiological emergency (2).

Dr. Ohnishi's article highlights the difficulty in assuring that contaminated food and water will not reach the marketplace. In spite of a rigorous system of monitoring, and because of the ability to detect very low levels of radioactivity, it is probable that a small fraction of the food or water supply will be contaminated after a radiological release. It is not possible to sample 100% of the food supply. However, by sampling across the whole spectrum of potentially contaminated foods, particularly milk, animal feed, seafood and crops growing during a release of radioactive material, it is possible to minimize the entry of these products to the market. The Japanese monitoring program was successful in identifying contaminated foods early and removing these products from commerce quickly. Although some products continued to be identified at later times, the fact is that the monitoring program did lead to interdiction. Of equal importance is the establishment of suitable criteria for interdiction such that, even if a small amount of contaminated food were to enter the food supply, it would not lead to a significant dose or risk to the public. Indeed, in some cases such as the green tea leaves, the Japanese criteria for interdiction may have been excessively conservative in that they did not take into account the dilution factor for the consumable portion of the leaves as brewed. Guideline levels should be sufficiently conservative to prevent harmful effects in the event of minor excursions.

The problem of managing radioactive contamination is one of risk management. In a situation where a large fraction of the food supply is contaminated and there are no alternative sources, it may be necessary to accept a higher risk from radiation to ensure adequate nutrition. However, to the extent that alternative food sources are available, food may be restricted at a lower level without jeopardizing the well-being of the population. As the country of Japan moves forward into recovery and into the next growing cycles, decisions will need to be made about the use of farm lands. The Japanese have demonstrated a good understanding of the technical issues involved and are working with international partners and standard-setting organizations to take prudent action.

The following are what we believe are some of the key points that would apply to the future management of a radiological/nuclear disaster and, indeed, many are applicable to any major disaster.

- More expertise in health physics and radiation medical issues is needed in U.S. government.

- There is need for experts in the state/local government and private sectors to be involved in radiation planning in their communities. This can come from the broad spectrum of expertise among societies such as the Radiation Research Society, Health Physics Society, American Society of Radiation Oncology, American College of Radiology, Society of Nuclear Medicine, Conference on Radiation Control Program Directors, and others.
- Timely and credible communication is essential (4). We found that public meetings that included questions and answers allowed us to describe complex issues and also to hear the concerns of the public.
- No-notice incidents such as this require advanced preparation and exercising. The Japanese demonstrated the importance of public preparedness and drilling.
- All aspects of the response including risk assessment, communication and the use of medical countermeasures need to be based on the best available science.
- Demonstration by scientists and researchers of an interest in solving the problems faced by the public is not only good science and service but is also a way to demonstrate to the public that there is a good return on their investment in science.
- The long-term ramifications from fear of radiation can turn a major disaster into an even bigger catastrophe for the involved region and county.
- Collaboration in medicine and science is a superb bridge for building trust among countries. These pre-existing relationships serve well in times of crisis.
- Decision-making, particular that relating to health and medical consequences, often requires deciding on an action based on the best available albeit incomplete information.

The Japanese and the world will be dealing with the consequences of this incident for decades to come. The information provided by Dr. Ohnishi is essential in learning the lesson from this unique crisis. Paraphrasing Dr. Ohnishi's closing remarks: "we must all learn from these events and plan more efficiently and effectively for the future."

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