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Communicating With Residents About Risks Following the Fukushima Nuclear Accident

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Abstract

The Fukushima nuclear accident in March 2011 posed major threats to public health. In response, medical professionals have tried to communicate the risks to residents. To investigate forms of risk communication and to share lessons learned, we reviewed medical professionals' activities in Fukushima Prefecture from the prefectural level to the individual level: public communication through Fukushima Health Management Surveys, a *Yorozu* ("general") health consultation project, communications of radiological conditions and health promotion in Iitate and Kawauchi villages, dialogues based on whole-body counter, and science communications through online media. The activities generally started with radiation risks, mainly through group-based discussions, but gradually shifted to face-to-face communications to address comprehensive health risks to individuals and well-being. The activities were intended to support residents' decisions and to promote public health in a participatory manner. This article highlights the need for a systematic evaluation of ongoing risk communication practices, and a wider application of successful approaches for Fukushima recovery and for better preparedness for future disasters.

Keywords

anxiety, Fukushima Daiichi Nuclear Power Station accident, psychological distress, radiation risk, risk communication, the Great East Japan Earthquake

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Introduction

The accident at the Tokyo Electric Power Company's (TEPCO's) Fukushima Daiichi Nuclear Power Station (FDNPS) following the Great East Japan Earthquake in March 2011 caused multiple public health problems. Although radiation exposure was limited,[1-4] the risk of exposure remains a serious public concern. High levels of psychological distress and decline in subjective well-being were observed among Fukushima residents, especially those who expressed great concern over radiation or distrust of government.[5,6] Post-accident medical studies have also revealed the exacerbation of physical illnesses such as diabetes and hyperlipidemia, especially in evacuees.[7,8] Concerns, to certain extent, derive from confusion caused by controversial "experts" opinions on radiation risks from the accident and increased distrust of government and experts.[9] However, these situations have led to a pressing need for communicating about health risks among residents, experts, and government authorities.

There are many varieties of definitions of risk communication[10-12]; one of the most prevalent definitions is "an interactive process of exchange of information and opinion among individuals, groups, and institutions," stated by the US National Research Council.[13] There were critical problems in risk communication prior to the accident, including limited activities with some exceptions (eg, meetings among local governments, citizen representatives, and TEPCO[14]), repeated propaganda concerning the safety of the FDNPS, a lack of municipal emergency plans outside a 10-km radius from the station, and a shortage of practical strategies for large-scale displacement.[15] Reflecting the significance of the accident, the United Nations Sendai Framework for Disaster Risk Reduction 2015-2030[16] addresses technological hazards and clearly states that the promotion of risk communication is one priority for achieving the seven global targets set in the framework.

In response to these situations after the accident, experts, such as medical professionals, have put considerable effort into communicating with residents about radiation and health risks related to the accident. Some activities are sporadically documented[17-21]; however, it is difficult to convey an overall picture of them. Comprehensive understanding of the objectives, approaches, successes, and lessons of the activities will be beneficial both in assessing risk communication in Fukushima now and in developing successful models for responding to future disasters. This article, therefore, overviews the experiences of medical professionals' risk communication activities implemented in Fukushima Prefecture in the aftermath of the accident with the aim of developing understanding about effective approaches and forms of risk communication in the context of nuclear accidents, and then summarizes lessons learned from these activities.

Methods

The risk communication activities overviewed in this article were selected based on the following criteria: (1) being implemented in Fukushima Prefecture, (2) being tailored to the needs of residents affected by the accident and beyond, and (3) being conducted by medical professionals. Risk communication through online media performed by a medical professional was also included in view of its important roles (Table 1).

This article focuses on medical professionals' risk communication activities that directly address health risks related to the accident at the community level; however, it is important to note that many actors other than medical professionals (eg, national institutions, non-profit organizations, and social scientists and other experts[12,22-25]) are also involved in information provision and communication activities within as well as outside Fukushima Prefecture. This methodology has created limitations for this article.

Table 1. Summary of Risk Communication Activities.

Institution	Activity	Objectives	Period	Extent	Partner
Fukushima Medical University (FMU)	Networking with media organizations	To promote media reporting of the Fukushima Health Management Survey (FHMS)	2012	Fukushima Prefecture	Media organizations
FMU	Expanding university PR channels	To improve university's information dissemination regarding FHMS	Since October 2012	Fukushima Prefecture	University health care professionals
FMU	Thyroid cancer screening briefings	To respond to improve residents' understanding of the screening program	Since November 2012	Fukushima Prefecture	Local professionals (eg, teachers, public health nurses)
FMU	*Yorozu* ("general") health consultation project	Response to general health consultation from individual inhabitants	Since May 2012	13 municipalities including evacuation order area	Medical professionals incl. outside of FMU
FMU/the University of Tokyo	Health Risk Communication Promotion Committee	To promote sharing and discussion of information on radioactive contamination so as to allow residents to think and judge for themselves	Since October 2012	Evacuation order area as well as evacuees outside of the village	Public health nurses, radiation protection experts
Nagasaki University	Reconstruction promotion base in Kawauchi Village	To support the reconstruction of Kawauchi Village through assessments of radiation status and individual consulting	Since October 2011	Kawauchi Village, Fukushima Prefecture	Residents of Kawauchi Village
Minamisoma Municipal General Hospital	Whole-body counter (WBC) screenings and counseling	To promote better understanding of radiation through conversation with examinees based on WBC results	Since July 2011	Fukushima Prefecture	Residents who participated in WBC screenings
Researchers in Minamisoma City and Soma City	Provision of scientific information through mass media, especially online media	To eliminate discrimination and harmful rumours by providing accurate, reliable information	Since May 2011	Internet and other media	Professionals from inside and outside Japan, especially at the University of Tokyo

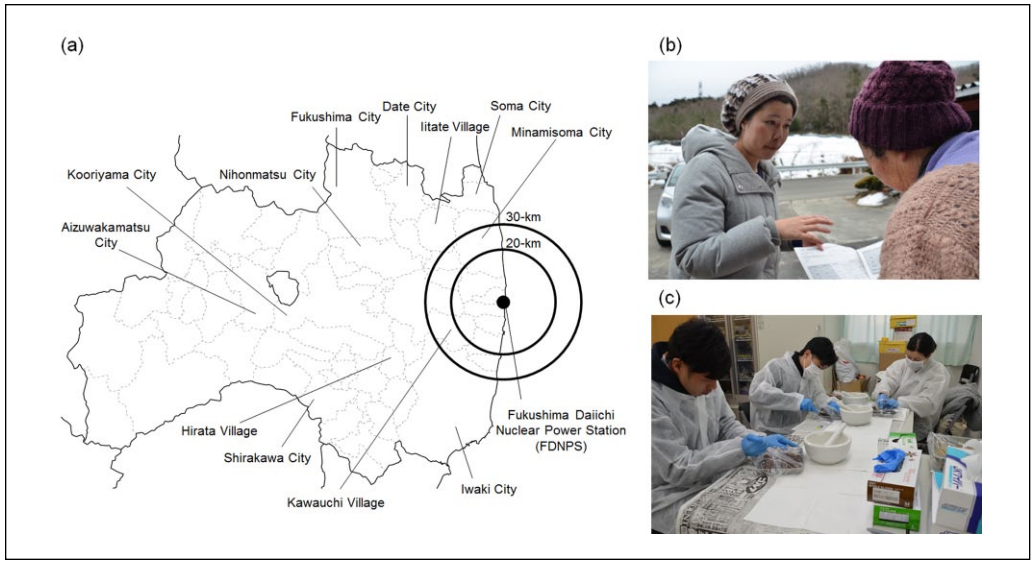

Figure 1. Risk communication activities in Fukushima. (a) Locations of municipalities in Fukushima Prefecture. (b) A resident consults a public health nurse on radiation exposure and health. (c) Preparation of mushroom samples for the measurement of radiocesium concentrations.

Public Communication Through Fukushima Health Management Surveys (S. Matsui and A. Goto)

Launching Communication Activities

In a survey in Fukushima City (Figure 1a) in 2012, a year after the accident, up to 80% of residents reported health concerns regarding radiation.[26] One factor contributing to these long-term concerns is community distrust of experts since the accident.[27] Three months after the accident, in June 2011, Fukushima Prefecture and Fukushima Medical University (FMU) launched the prefecture-wide Fukushima Health Management Survey (FHMS) to monitor health status.[28] However, residents did not clearly recognize or understand the purposes and results of the FHMS, so the university established the Public Relations Promotion Office (PRPO) in April 2012 to help them understand the purpose and significance of the FHMS and to rebuild their trust in experts. We propose a set of principles for risk communication based on a review of communications between residents and experts by the PRPO between 2012 and 2013.

Three Types of Communication Activities

The PRPO implemented 3 types of activities:

The first activity was designed to disseminate information through the media and thus to reach a wide audience. However, it was difficult to get media organizations, which prioritize the newsworthiness of their reports, to report on a complicated survey over a year after the project began. We asked about 10 news organizations to report about the FHMS, but only 3 organizations reported a total of 7 times, mostly in relation to screening for thyroid cancer. We also held 2 meetings with representatives of media organizations: 9 organizations in the first meeting and 8 in the second. The representatives responded favorably; they stated that they finally understood the purposes of the FHMS, and that such meetings should have been held earlier.

Table 2. Fukushima Health Management Survey Meetings on Thyroid Cancer Screening.

Region		Municipality	Date (Y/M/D)	Participants (n)	Evaluation[a] (% Understood)
1.	Central	Koriyama City	2012/11/3	Approximately 70	57
2.	Central	Fukushima City	2012/11/10	243	77
3.	Coastal	Minamisoma City	2012/11/18	41	95
4.	Coastal	Iwaki City	2013/1/27	48	94
5.	Central	Nihonmatsu City	2013/2/10	84	90
6.	Central	Shirakawa City	2013/2/24	98	100
7.	Central	Date City	2013/3/10	51	86
8.	Mountainous	Aizuwakamatu City	2013/3/24	62	76

[a]We asked participants to evaluate the meetings on a scale of 1 to 4: 1, understood very well; 2, understood OK; 3, not understood well; 4, not understood at all. Results are the sums of 1 and 2. This was an anonymous survey conducted for quality improvement of the university's communication activities, and is outside the scope of the ethical guidelines.[29]

The second activity was disseminating information via the PRPO's own channels. We improved our website and created leaflets to explain the FHMS. However, critical feedback said that these efforts were a waste of taxpayers' money and that people did not want to hear explanations from "government-sponsored researchers". This activity has, however, continued as a requirement of the university in order to provide opportunities for residents to obtain information on the FMHS.

The third activity was setting up of thyroid cancer screening briefings at which thyroid physicians communicated directly with residents. The meetings were held at public community centers and other convenient locations and were announced through newspaper advertisements to reach evacuees (Table 2). The physicians explained the screening procedures, gave a program overview, and explained how test results were assessed. Eight meetings were attended by approximately 700 people. One of us who implemented the activity faced a situation in which residents and members of citizen organizations yelled in anger and jeered during many of the meetings, owing in part to their distrust of government and related groups. Although the meetings proved difficult to run, the opportunities allowed us to understand residents' feelings and needs, and to gauge what they found difficult to understand.

The participants were asked to evaluate the meetings. The proportion who understood the content increased from 57% at the first meeting to 100% in the sixth, but declined again in the last 2 meetings (Table 2). Participants' interest moved from general information about the FHMS to more detailed information related to their personal circumstances: such as whether their children were safe, whether it would be better for them to continue living in evacuation shelters, and where they could be tested locally. Therefore, we invited questions before the meetings so that we could prepare answers in addition to our basic materials. We also asked local school teachers, school nurses and public health nurses to join our activities as communicators.

Four Communication Principles

On the basis of the above experiences, we suggest following 4 principles in establishing communication which meets community needs in a health crisis: "Setting," "Scale," "Content," and "Communicator." We call these "2 Serve Communities" principles based on the initial letters of the principles including 2 Ss and 2 Cs (Figure 2).

In the communication *setting*, we tried first to convey information via the media to reach the largest number of people. But this method was reliant on the media organizations to send the information and on residents to acquire the information, and it was not as effective as expected. To ascertain and respond to individual information needs, it was important to *make direct contact with those in need of information*.

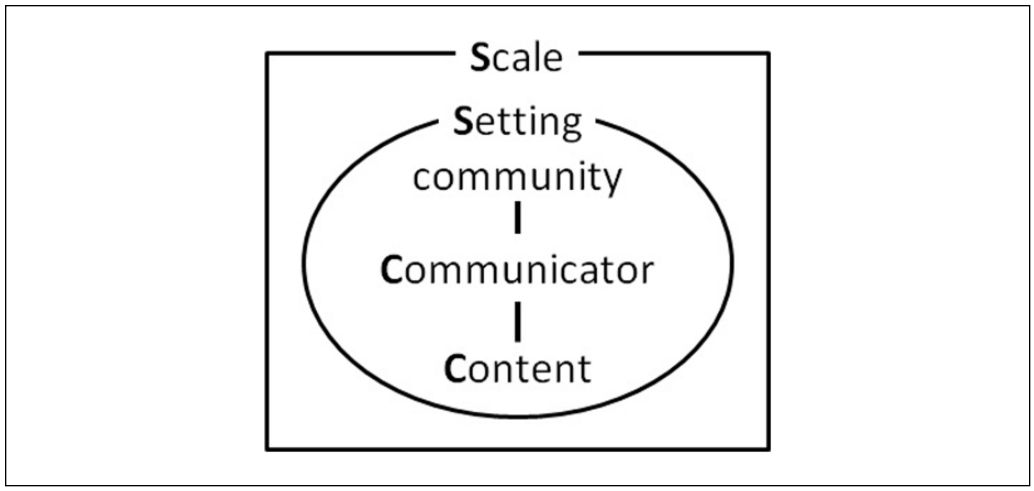

Figure 2. "2 Serve Communities" principles of communication in health crisis.

In the *scale* of communication, as in the "setting," we found that it was difficult to respond to individuals when we held meetings in large venues. To meet diverse individual needs, we found it necessary to *interact at a scale that allowed face-to-face communication*.

For the *content* of the communication, we prepared standardized explanatory materials so that our communications would remain consistent. Although the core content remained the same, the materials were constantly *revised in the light of the responses from recipients*.

The *communicator* was usually a physician, who provided medical and health information. We found that it was important to *work also with local community experts* on whom the residents depended (eg, teachers and public health nurses), who could speak as community voices when residents were hesitant to speak up.

The above changes in the 4 principles could be explained more broadly as a shift from mass audiences to specific groups targeting types of communication and incorporating a participatory approach.[30] Similar approaches, particularly about individual-level communication and community involvement, were employed after the Chernobyl accident.[31] Our lessons learned are in line with a recent shift in efforts to improve understanding of patients and residents toward placing more importance on improving the skills of health care professionals who disseminate the information.[32] Even during a health crisis needing an urgent response, it is important to test the form and content of communication and seek feedback on whether the information is appropriate and easy for the intended audience to understand so that the content can be better received.[33] The US Centers for Disease Control and Prevention has developed practical materials for effective communication for health professionals to use in a crisis situation.[34] Likewise, our 4 principles listed above can serve as a means to guide an interactive relationship between health care professionals and the community, and are relevant to any major health issue.

Dialogue With Evacuees: *Yorozu* (General) Health Consultation Project (A. Kumagai)

The Situation

After the Fukushima accident, we used large-scale lectures and one-to-one consultations to communicate health risks. Although each approach was effective, we developed new approaches in the light of lessons learned.

During the acute phase following the accident, large-group and one-way communications such as lectures and press releases met the common need for information and decisions. But government and experts had to act under uncertainty, and it was difficult to do other than listen to personal anxieties, as there was no well-founded information available.

During the chronic phase after the immediate crisis had passed, a unified approach was no longer enough to address personal problems and anxieties, as a diversity of available information became available and people's perceptions developed. One-to-one or small-group communication thus became necessary.

Responses and Lessons Learned

FMU started one-to-one *yorozu* ("general") health consultations run by local government public health nurses in 2012 to provide positive support. We had already experienced that people could not share their real concerns easily. We could hear their radiation anxieties if they considered us to be reliable persons. We were concerned that if we limited the consultation topic to radiation exposure, people might hesitate to express their anxieties because the topic had already become taboo,[35] so we did not impose any limits on topics. People expressed anxiety about radiation, but the nurses had not been educated about its health effects.

We set up booths at public health-check venues and listened to people's concerns, but we responded individually to questions from the nurses and provided educational material for them. By fiscal year (FY) 2015, 4889 people had attended, but fewer than expected asked about radiation exposure. Furthermore, the proportion of radiation consultations to all consultations dropped from 12.3% in FY 2012 to 4.4% in FY 2015.

Better understanding of the radiation situation in Fukushima is one explanation for the low proportion of consultation about radiation. Others are that people have become used to the situation with the passage of time, and that other issues have become important. However, the main reason was that the issue had become "taboo": many people could not get reliable information during the crisis, and some were afraid of conflict due to differences in perceptions of risk. Thus, people's anxieties remained hidden. Furthermore, they found it difficult to express taboo concerns with outsiders such as ourselves.

So, to approach people who did not want to share their concerns, we held discussions with small groups such as mothers' groups or neighborhood associations and listened to them talk about their current situation, anxieties and problems. This allowed us to build rapport with them while we collected data. The approach proved effective at preventing unscientific decision making based on rumor. Local public health nurses could offer such support activities to local communities.

Peer Group Sessions in Iitate Village (Y. Kuroda)

Iitate Village, with a population of around 6100 in 2011, is considered one of the most beautiful villages in Japan. Most of the residents earn their livelihood from agriculture and cattle breeding. Lying roughly 40 km northwest of the FDNPS (Figure 1a), the village was not designated as an evacuation order area immediately after the accident. Many residents were reassured by medical experts' initial opinions on radiation exposure and by a government announcement that "levels of radiation would not immediately affect the human body." However, the entire population of the village was evacuated by government order on April 22, 2011, more than a month after the accident. Villagers expressed a great sense of distrust toward statements from experts, information disclosed, and the response by government and public administrators. Since distrust is known to inhibit communication, events did not proceed smoothly.

Risk Communication by Disseminating Knowledge

In the context of Iitate Village, we define "risk communication" as "promoting the sharing and discussion of information regarding radioactive contamination so as to allow residents to think and judge for themselves." Risk communication activities have been deemed a pillar of recovery measures in Iitate Village.[36] In a whole-village survey performed in May 2012, the response chosen most frequently was "There are numerous opinions and I do not know which one is true" (72.2%), followed by "I definitely want opportunities to learn more about how radiation affects the human body" (41.6%).[18] It became clear that the quantity of information left many residents confused.

Women with children, village representatives, school teachers, medical doctors and radiation specialists, and public officials in Iitate Village established a "health risk communication promotion committee" in October 2012. They conducted "peer group sessions" with residents in temporary housing, mothers of children in nursery school, school teachers, and employees of companies within the restricted area. Local health professional have an important role in creating links between experts and local residents. Through the activities, we confirmed that people in the same situation can share their experiences and learn from each other. The sessions directly involved the inhabitants, and helped the local authorities and professionals to overcome the difficulties caused by evacuation. Risk communication activities started to be managed by not only local authorities or professionals but also by some residents in communities. They also published a quarterly magazine about general health and radiation, and strived to disseminate information to villagers who were evacuated outside the prefecture.[37]

Further Measures Needed

The implementation of risk communication activities by many institutions in the early phase of evacuation tended to reinforce the perceived ambiguities and consequently generated social distrust. Interventions to disseminate knowledge about radiation exposure had a limited role in regaining control. The need to develop comprehensive and inclusive approaches for communicating with regard to radiation risk is widely recognized.[25,31] Based on measurements of ambient and personal radiation levels, the results can be discussed among residents, local health professionals and experts. These approaches are useful to find the solutions among stakeholders.

Comprehensive Radiation Risk Assessment for the Reconstruction of Kawauchi Village (M. Orita and N. Takamura)

Evacuation and Return

Kawauchi Village, with a population of 2759 (April 2016), lies about 20 km southwest of the FDNPS, partly within the evacuation order area (Figure 1a). Following the accident, most residents were evacuated at the mayor's decision during the emergency phase. Later, however, it was revealed that the radiation contamination level in the village was lower than in other local authorities within 30 km of the FDNPS on account of the wind direction during the initial release.[38] In January 2012, the mayor declared that residents could safely return to their homes. The village reopened schools, a medical facility and food shops in April 2012 to facilitate the residents' return. As of May 2016, 1781 of 2573 residents (64.7%) had returned.[39] The proportion of return of Kawauchi Village was relatively higher than other local areas such as Naraha Town (15.9%).[39] Our experiences in Kawauchi Village have suggested that scientific support and communication of radiation health risks are needed to reassure residents who are still considering returning to

their home town. Details of the scientific support and the communication in Kawauchi Village are described below.

Interventions

Measure of Environmental Contamination Levels. Nagasaki University has been assisting Kawauchi's reconstruction efforts since December 2011 by providing scientific support for the residents' return and communicating risks. The aim of the university is to establish a model for reconstruction following a nuclear accident through the close cooperation of residents, local authorities, and specialists. We believe that such information will help other local authorities in reconstruction.

Before the villagers began to return, we collected soil from the village to measure the concentrations of radionuclides and to estimate radiation doses received by residents. We showed that returning was scientifically justified.[40] In May 2012, a public health nurse from the university arrived to provide individual consultations on radiation exposure and health.[41] Frequently asked questions included "What is the difference between radioactive materials and radiation?," "What is the purpose of the decontamination?," "Are water and rice safe?," and "Is it safe for children to play outside?"

Establishment of Satellite Facility. In April 2013, the university and the Kawauchi local government signed an agreement to cooperate in reconstructing the village, and the university established "the Nagasaki University/Kawauchi Village reconstruction promotion base." The aims of the base are to evaluate the effectiveness of decontamination through the measurement of radionuclides in soil and of ambient doses; to evaluate the risks of internal exposure through the measurement of foods and drinking water; to provide health consultations with inhabitants, including evacuees, according to the results of the measurements; and to promote the health of inhabitants by improving the prevention and management of lifestyle illnesses. Public health nurses trained in radiation health effects and risk communication have been working at the base (Figure 1b).

Further Monitoring. In addition, the university has evaluated individual doses of radiation as measured by personal dosimeters worn by residents who temporarily stayed within the evacuation order area, and showed that the doses were limited.[42] We shared these data with residents and explained that they could return to their homes. The village office lifted the evacuation order for part of the evacuation order area and allowed residents to return there from October 2014. The university also collected wild mushrooms from the village every year to measure their radiocesium concentrations and calculate the internal exposure dose by consuming mushrooms to estimate the risk of internal radiation exposure (Figure 1c).[43] The results were summarized for risk communication with residents to prevent excessive internal exposure.

Use of the Whole-Body Counter as a Communication Tool (M. Tsubokura)

The whole-body counter (WBC) measures internal contamination levels by detecting radiation emitted from within the body. Since immediately after the accident in March 2011, widespread WBC screening in Fukushima Prefecture and its surroundings has found that the levels of internal contamination of residents in Fukushima were much lower than those in Chernobyl. These results were published in academic journals and got wide media coverage.[44,45]

WBC measurements have also been used as a tool for risk communication between radiation experts and local residents in Fukushima through the 2 methods described below.

Advice on Dietary Habits Based on Screening Results

Most cases of chronic internal contamination are caused by consumption of contaminated food, and WBC results can reflect the frequency of past consumption of such food. Therefore, results have been used for lifestyle advice on foods to avoid or for confirmation of food safety.[17]

In Minamisoma Municipal General Hospital, where WBC screenings were started in July 2011,[46] outpatient counseling was offered for people with >20 Bq/kg of ^{137}Cs. A physician explained the results to each examinee and offered to discuss lifestyle choices with a focus on food selection. Such consultations offer an opportunity for people to understand radiation and related problems.

Creating Opportunities for Conversation With Examinees

As residents' interest in radiation-related problems gradually waned, radiation lectures targeting a mass audience and mass media became ineffective for communicating information about radiation; however, their understanding may not be sufficient. To create better understanding of radiation, it has become important to provide proactively opportunities for face-to-face dialogues between radiation specialists and residents.

A new WBC for children younger than 6 years, named "Babyscan," was developed to promote communications between radiation specialists and local residents especially young mothers with small children. Hirata Central Hospital began a Babyscan screening program in December 2013.[47] Counseling sessions with parents have created opportunities to talk about radiation, something that was not possible before the introduction of Babyscan.

The WBC has become an effective tool for risk communication. First, WBC screening can provide people with the opportunity to directly measure their own radiation doses rather than relying on average or district values. Second, it creates the opportunity to talk directly with individuals about the realities of radiation. Third, in contrast to thyroid screenings, WBC screening seldom requires further visits or interventions.

On the other hand, WBC screening is in no way an all-purpose tool. First, it can provide little help in reducing radiation risks. Second, when internal contamination is detected, the flames of anxiety may be fanned. Even when doctors explain that a level is unlikely to have any health effects, many examinees will change their dietary habits or lifestyle out of fear, or reject further screening.[17] Individual interventions and methods of explanation by medical staff require further improvement.

In summary, WBC screening offers public health value in terms of not only radiation monitoring but also risk communication between residents and radiation experts.

Processing Scientific Knowledge for the Media (S. Ochi)

In this information-intensive era, "black swan" events[48] such as nuclear accidents easily amplify risk, through a chain of events in which a specific risk is magnified, in turn causing secondary social, political, and economic consequences.[49] In such situations, scientists can play pivotal roles in mitigating social disturbance by providing reliable scientific information through the media. Online media are especially useful in responding promptly to public anxiety.

This section describes the transition of information needs after the 2011 nuclear accident and how researchers in Minamisoma City and Soma City used the media to respond to needs.

Initial Phase: Media Hype

Immediately after the nuclear accident, there was a period of "media hype": a positive feedback loop enabled by the self-referential nature of mass communications.[50] The media called the accident the "Fukushima apocalypse," and some people repeated false news that there was an increase in malformed babies and cancers in Fukushima.

A good counter against such hype was to disseminate vital primary information *from within* the accident area. For details, see the previous section by M. Tsubokura, who works in Minamisoma City and who disseminated data on radiation exposure levels among residents in the newspaper and in online blogs.

Second Phase: Deliberately Exaggerated Rumors

After this chaotic period came a period of more deliberately exaggerated or fabricated rumours, exemplified by an "alarmist interpretation" of an increased rate of thyroid cancer among children in Fukushima.[51] Although specialists attributed this high incidence rate largely to the "screening effect," the explanation did not reach lay people in the same volume as sensational words in Internet gossip.

This case clearly suggests that scientists have to provide tools for the interpretation of information[52] in plain language. This is why S. Ochi wrote an online article,[53] which describes how misinterpretation of rates of thyroid cancer in Fukushima can skew real-world interpretation. Within a month, it was shared thousands of times on social networking service and viewed 10 times more. A comment on Twitter said, "Doctors rarely make detailed comments on topics snubbed by specialists, as this article did. But to lay people, the silence of specialists looks as if they are hiding the truth."

Late Phase: Narrow Focus on Risks

Health risks after the accident were not limited to those of radiation exposure, but included many other factors such as long-term displacement.[54] However, by focusing too much on radiation, people can lose their overall view of health. Considering that the aim of risk communication is to protect the collective health of the residents, at some point scientists need to pull people back to this original purpose. In particular, health risks invited by avoiding exposure to radiation, such as reduced physical activity due to staying indoors,[55] must be addressed.

Although non-radiation health risks also needed to be considered immediately after the accident, strong fears of radiation prevented residents from paying attention to other health risks in the initial phase. It was not until recently that residents came to understand the comparison of radiation risks with other health risks. Therefore, fostering people's media literacy and skills of knowledge integration *before* a crisis seems essential to effective communication *after*.

Lessons Learned

Accurate scientific information is essential to successful risk communication. However, such materials often make sense only when provided according to a recipe or menu (holistic view), with a homemade taste (in familiar language).

Summary and Perspectives

Although medical professionals' communication activities have been targeted at different levels, they share some similarities. Overall lessons learned in this article (Table 3) highlight the use of

Table 3. Summary of Lessons Learned From Risk Communication Activities.

Institution	Activity	Lessons Learned
Fukushima Medical University (FMU)	Networking with media organizations	"2 Serve Community" principles can foster an interactive relationship between health care professionals and the community: "Setting," "Scale," "Content," and "Communicator"
FMU	Expanding university PR channels	
FMU	Thyroid cancer screening briefings	
FMU	*Yorozu* ("general") health consultation project	People cannot share their radiation anxieties easily and update their initial perceptions. We should keep the individual consultation and small group discussions with local key persons
FMU/the University of Tokyo	Health Risk Communication Promotion Committee	Perspectives on risk among evacuees should be jointly examined. In this case, local health professionals have an important role in creating links between experts and local residents
Nagasaki University	Reconstruction promotion base in Kawauchi Village	After the nuclear disaster, scientific support and communication of radiation health risks are needed to reassure residents who are still considering returning to their home towns
Minamisoma Municipal General Hospital	Whole-body counter (WBC) screenings and counseling	WBC measurements have been used as a tool for risk communication through (1) advice on dietary habits based on screening results and (2) creating opportunities for conversation with examinees.
Researchers in Minamisoma City and Soma City	Provision of scientific information through mass-media, esp. online media	Accurate scientific information is necessary but not sufficient for effective risk communication. People often need "recipes" for using the information (ways of interpretation) with a homemade taste (in familiar language)

scientific data. The delivery of scientific data is essential for risk communication, as pointed out by Shore,[56] the co-chair of a scientific panel for a report from the World Health Organization.[57] The effectiveness of providing scientific objective data was also demonstrated in a previous study[58]. Furthermore, the activities presented in this article emphasized a growing focus on interactive communication to encourage public engagement and to respond to needs. Through these activities, medical professionals can work as a bridge between residents and local governments. Various materials published by international institutions also emphasize the importance of interactive dialogues among concerned stakeholders for coherent and integrated disaster-management operations throughout the course of decision making, planning, and implementation.[59-61] Note that information has also been extended from radiation risk to comprehensive health risks and well-being. Since increases in physical and psychological health risks were revealed after the accident, medical professionals have implemented risk communication not only to support affected people's decisions through a democratic process, discussed by the US National Research Council,[13] but also to promote overall public health through a participatory approach. These two

objectives are not contradictory, but can be approached in parallel. Since problems of public health and science ethics in Fukushima continue, medical professionals must conduct effective communication that protects people's health.

In Fukushima, more municipalities are now preparing to end the evacuation zoning, possibly provoking concerns about radiation risk and life after returning. It is critical to continue closely monitoring public health status, communicating health risks, and providing assistance. Recent reports[62,63] show that affected people's psychological and physical health has been gradually improving. The issues, however, are still prominent, and factors contributing to the improvement have yet to be unravelled. Importantly, the issue of a nuclear accident is not only a matter for Japan, but also for other nations engaging in nuclear industry. A logical next step is to evaluate the effectiveness of risk communication activities. The development and expansion of a successful risk communication model is important to Fukushima's recovery and to sharing lessons for better global preparedness for future disasters.

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