The structuralization of risk communication work and objectives in the aftermath of the Fukushima nuclear disaster

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ABSTRACT

Researchers have not comprehensively considered the contents and objectives of risk communication. In this study, interviews were conducted with 10 risk communicators who worked on risk communication of the various health risks arising after the 2011 Fukushima nuclear disaster in Japan. We focus on extracting, codifying, and summarizing the contexts, content, and objectives of their work. The objectives of risk communication were identified as "alleviating anxiety and stress," "supporting decision-making," "gaining trust," "promoting understanding," "deepening mutual understanding," and "sharing values and empathy"; moreover, there are new additions of higher objectives: "returning to normal life" and "cultivating a wider perspective." It was suggested that professional expertise, cooperation, and collaboration support and facilitate the attainment of these risk communication objectives. We anticipate that the findings of this study can assist in establishing effective risk communication practices based on the careful consideration of risk communication objectives, social debate on their legitimacy, and the evaluation of their effects.

1. Introduction

The Great East Japan Earthquake and the subsequent Fukushima Daiichi Nuclear Power Station disaster on March 11, 2011, in Japan resulted in the emission of radioactive substances into the environment [1]. Although radiation exposure was, fortunately, limited [1], concerns over the disaster remain as it continues to cause radiation exposure as well as other physical, psychological, and social health-related risks [2–8]. Mental and physical health issues have appeared in the form of increased psychological distress and lifestyle diseases, particularly among evacuees [2–4]. Further, along with changes in social factors such as reduced income, loss of employment, and community fragmentation crises, there are challenges related to discrimination, stigma, and reduced well-being [5–8].

Amid these risks, medical professionals, experts, nonprofit organizations (NPOs), and the government of Japan engaged in risk communication in the immediate aftermath of the Fukushima nuclear disaster [9–15]. First, communication regarding radiation risks was provided through information sessions organized immediately after the disaster, which gradually developed into collaborative work rooted in daily life and general health [9]. Conversely, it has been argued that risk communication undertaken since the Fukushima nuclear disaster has not been successful [16]. However, evaluating the effects of risk communication is not straightforward, in part because the objectives of risk communication vary. For example, the United States National Research Council posits that "risk communication is successful to the extent that it raises the level of understanding of relevant issues or actions and satisfies those involved that they are adequately informed within the limits of available knowledge" [17]. The United States Nuclear Regulatory Commission provides the following examples of objectives of risk communication: "to provide information," "to learn about stakeholders' concerns," "to build trust and credibility," "to ask stakeholders for input in a decision-making process," and "to influence people's behavior and perceptions about risk" [18]. Renn indicated that risk communication must aim at "providing people with all the insights they need in order to make decisions or judgments that reflect the best available knowledge and their own preferences" [19]. While a systematic clinical review of risk communication evaluates its effects with regard to promoting understanding, satisfaction with the communication, and acceptance of intervention [20], the objectives of communicating health risks from a public health perspective in the aftermath of a nuclear disaster are more diverse.

However, to date, few attempts have been made to consider risk communication in an exploratory manner that allows its content and objectives to emerge organically. In particular, only a few studies have focused on risk communication from the perspective of nongovernmental actors rather than risk management authorities. There is a need to extract and categorize the indicators of the content and objectives of communication work on the health risks that arise after nuclear disasters [21]. Qualitative research that understands the overall implementation process of multiple risk communications and binds as well as evaluates its content and objectives can be expected to contribute to its effective implementation.

In this study, risk communicators, working on communication regarding health risks that have arisen following the Fukushima nuclear disaster were interviewed to analyze the content and objectives of their work. These interviews categorized and structured the content of their work as well as its foundations and objectives. We prepared this paper after the addition of results and discussion to an abstract at a conference presentation [22] and a report for the Research on the Health Effects of Radiation organized by the Ministry of the Environment, Japan [23].

2. Research method

2.1. Study design

In this study, we employed a qualitative descriptive study design to clarify the communicators' experiences and thoughts on their activities after the Fukushima nuclear disaster.

2.2. Research subjects

The subjects were communicators who worked on the risk communication of various health risks in Fukushima Prefecture after the Fukushima nuclear disaster. Following repeated consultations among researchers participating in the project until we reached theoretical saturation and considering a balance of sexes, occupations, and areas of activity, we selected 10 communicators who had achieved results through vigorous dialogue with the residents of Fukushima Prefecture and invited them to participate in this study.

With regard to the occupations of the 10 communicators selected, there were 2 doctors, 1 public health nurse, 1 nursery teacher, 1 cram schoolteacher, 2 local government officials, and 3 NPO employees. Their sex, occupation, activity examples, settings (how many residents were targeted at each occasion of communication), and area of activity are presented in Table 1. The regions of Fukushima Prefecture are presented in Fig. 1.

2.3. Data collection

Semi-structured interviews lasting approximately 1 h were held with each subject once at a place of their choice between July and September 2018. We interviewed the subjects using an interview guide that included such categories as the circumstances, objectives, and content of their work, changes before and after their work, and the effects of their work. With the consent of the interviewees, the interviews were recorded using an IC recorder. The interview guide is provided in Appendix A (Supplementary Material).

2.4. Analysis method

A qualitative description analysis was used, and we transcribed the recordings verbatim to analyze them. We examined contexts in which the content and objectives of the communicators' work could be perceived from the data, which we then extracted and codified. The coding was performed by a single researcher (KH). Each example created codes that we then divided into work, foundations, and objectives; we then aggregated the sections with similar codes and extracted subcategories. The relationships and content of the aggregated subcategories were scrutinized, categorized, named, and abstracted through discussion among the three researchers. During category extraction, we took care in abstraction to return to the data and codes. For the similarities and differences between the subcategories and categories, the consistency of analysis content was repeatedly confirmed among the three researchers. We divided the extracted categories into different sections in the analysis: the content of risk communication work relating to the health risks that arose following the Fukushima nuclear disaster, their foundation, and the objectives of the communicators' work.

Table 1
Summary of interviewees.

Interviewee number	Sex	Occupation	Activity examples	Settings[a]	Region
1	M	Doctor	Consultation through internal dose testing; education for children	One-on-one[b]	Soso (an area to the north of the Daiichi nuclear power plant)
2	F	Doctor	Communication through mass media	Large Group[c]	Soso (an area to the north of the Daiichi nuclear power plant)
3	F	Public health nurse	Health education and consultation on radiation	Small Group[d]	Nakadōri (an area in the middle of Fukushima Prefecture)
4	M	Public relations (public university)	Publicity activities on radiation risks	Large group	Fukushima Prefecture
5	M	Local government official	Decontamination activities by local governments	Large group	Nakadōri (an area in the middle of Fukushima Prefecture)
6	F	NPO[e] work, residents	Support for local communities	One-on-one/small group	Iwaki (an area to the south of the Daiichi nuclear power plant)
7	F	Nursery teacher	Responding to radiation anxiety in infants and mothers	One-on-one/small group	Nakadōri (an area in the middle of the prefecture)
8	F	NPO work, residents (including out-of-prefecture evacuees)	Support for evacuees inside and outside Fukushima Prefecture	Small group	Fukushima and other prefectures
9	M	Cram schoolteacher	Health consultation regarding radiation	Large (medium) group	Nakadōri (an area in the middle of the prefecture)
10	F	NPO work, residents	Childcare support	One-on-one/small group	Iwaki (an area to the south of the Daiichi nuclear power plant)

[a] Settings represent how many residents were targeted at each occasion of communication.
[b] Risk communication targeting one person.
[c] Risk communication targeting hundreds of people.
[d] Risk communication targeting several dozen people.
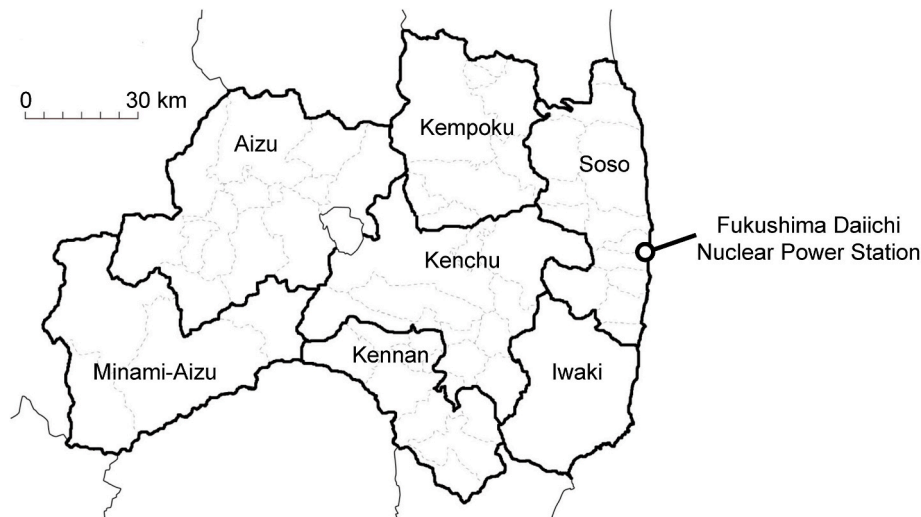[e] NPO: nonprofit organization.

Fig. 1. Regions of Fukushima prefecture. Nakadōri: Kempolu, Kenchu, and Kennan.

2.5. Ethical considerations

When conducting the interviews, we explained the study's objective and method, the freedom of the subjects to participate and their rights to withdraw consent, and how the data would be stored and then disposed of after completion. This explanation was given both in writing and verbally, and the participants signed consent forms. The study was conducted with the authorization of the Ethics Committee of Fukushima Medical University (authorization number: General 30047) and the participants were awarded 14,000–17,000 Japanese Yen once unless they were receiving a salary from the Fukushima Medical University or declined the award.

3. Results

3.1. Risk communication activity content and objectives

A total of 8 categories (C1–C6, B1–B2) regarding risk communication work content and its supporting basis were extracted, comprising 29 subcategories and 95 codes (Table 2). With regard to risk communication objectives, 8 categories (O1–O6, HO1–HO2) were extracted, comprising 25 subcategories and 100 codes (Table 3). The relationships between activity content and objectives were organized and the structuralized result is presented in Fig. 2. In the text below, the categories are placed within square brackets ([]), subcategories are placed within double inverted commas (""), and the representative interviewee narrative for each category is provided in italics within double inverted commas ("").

3.2. Risk communication activity content

3.2.1. Activities for risk communication work

3.2.1.1. C1) [working to support security and stability]. In dialogue and communication with the residents, the communicators "took residents' concerns seriously" by considering their stress as well as being mindful of their anxieties and listening to their stories. Moreover, the communicators "responded to individual concerns," learning about the residents' needs through questionnaires and other means, and occasionally creating an environment that enabled the residents to feel that they could talk to them whenever they wished. They were also involved in "supporting the residents' security" by creating an understanding that dealing with radiation was more important than its numerical figures; they also visualized the radiation and clearly explained every radiation

countermeasure that was adopted.

"I felt I had to answer each individual concern: What water was being used, what the ingredients were like, and so on. In order to visualize it all, I put a transparent sheet over the whole entrance, I put sheets on shoe boxes … I made the dangerous things visible and tried as much as possible to explain to everyone that this was how far we had gotten with countermeasures in a concrete manner and did so one-by-one."

3.2.1.2. C2) [coordinating the resources required for informed decision-making and evaluations]. In study groups and information sessions, the communicators "waited for the other person to get there" without attempting to persuade or unnecessarily interfere with the residents, and "dedicated themselves to the role of the listener" by limiting themselves to only answering the questions that the residents asked. On multiple occasions, the communicators intentionally held back from saying something despite their knowledge in order to "be vigilant in allowing the residents to make their own decisions wherever possible." They connected the residents with one another so that they could talk among themselves and, when the information they could provide was deemed incomplete, they would continually provide more information that could be examined by the residents in order to "connect the people and information required to make judgments and evaluations."

"It is enough if they return home with some level of information, but when that information is incomplete … at the very least, I would suggest something very simple like if they go to that department they can find that out, or if they go on this website and search then they'll understand that."

3.2.1.3. C3) [connections designed to restore relationships]. In order to restore relationships between the residents and the related parties, the communicators stated that they "engaged frankly as a fellow human," explaining the work they were doing even if it was later and speaking honestly with the residents even if doing so was disadvantageous for their organization. They also stated that in study groups and information sessions, they would "answer resident's questions in a reliable manner" and "engaged having considered the backlash from the residents," such as by discussing radiation after having built a relationship with the residents. They also steadily built relationships where there had been misunderstandings that led to distrust of the government, and worked to go out themselves and "construct new relationships with residents," who were dismissive regarding the work of the communicators.

Table 2
Risk communication work content and its supporting foundations/background (numbers in parentheses represent the interviewee number).

Category	Subcategory	Code
C1. Working to Support Security and Stability	Take the residents' concerns seriously	Understand the residents and listen when they vent (10)
		Take care when listening to others talk because of the underlying stress in consultations (8)
		Places where the residents who do not want their fears to be known can vent about how they feel (10)
		Even if the story you hear is as expected, do not let it end by saying "it is alright" (10)
	Respond to individual concerns	Respond to individual concerns of the residents even after radiation countermeasures have been taken (7)
		Take surveys of all the residents' opinions (7)
		Handle people who do not want to be made to eat meals provided for them on an individual basis (7)
		Stay engaged with the residents' unease until the end (10)
	Support the residents' security	Visualize radiation for any children and adults with concerns (7)
		Provide concrete explanations of each decided countermeasure to everyone (7)
		Regarding the residents' concerns, how radiation is dealt with is more important than its numerical figures (7)
C2. Coordinating the Resources Required for Informed Decision-making and Evaluations	Wait for the other person to get there	Explain and then leave the decision to the guardians (7)
		Do not attempt to convince the residents in study groups (2)
		Do not cut off the conversation unless the other person says so (10)
	Be vigilant in allowing the residents to make their own decisions wherever possible	For them to be convinced they need to decide for themselves, so no suggestions are made from this side (5)
		I let them know that if there are concerns regarding radiation, I can provide support and explain it—for example, with measurements—but I do not interfere beyond that (6)
		I have the necessary information, but I hold back from providing it (8)
		Even when I go in as the facilitator, I do not tell them how to do it (8)
	Dedicate themselves to the role of the listener	The initial time in information sessions is just to answer the residents' questions (5)

Table 2 (*continued*)

Category	Subcategory	Code
		I dedicate myself to listening to what the residents say (8)
		My days pass with information sessions where I merely listen to the residents, without deciding or attempting to persuade them of anything (5)
	Connect the people and information required to make judgments and evaluations	In round-table discussions, I lend out integrated dosimeters with actual readings and provide explanations to questions regarding radiation (3)
		When the information users want is incomplete, I will at the very least connect them to information that can be examined (10)
		I create environments where guardians can get the answers they want (7)
		I connect the residents, so they can talk about their concerns and worries (8)
		I provide information to the residents for them to make decisions (8)
		Support is about connecting people with other people (3)
C3. Connections Designed to Restore Relationships	Engage frankly as a fellow human	Provide full explanations even if delayed (4)
		Be honest even if it is disadvantageous for the organization (4)
	Answer the residents' questions in a reliable manner	Hold information sessions where questions can be answered on the spot (4)
		Take questions before information sessions, so they can be responded to at the venue (4)
	Engage having considered the backlash from the residents	Only talk about radiation once a relationship has been created (3)
		Maintain the position of being an outsider (6)
		Do not rely on the government or Tokyo Electric Power Company Holdings because of the probable backlash from the residents (5)
		Fix a point of contact to avoid conflict with the residents (5)
	Construct new relationships with the residents	Steadily build relationships where misunderstandings are causing distrust of government (8)
		Go to those who are negative about the government (3)
		Be cheerful no matter where you are and get out the message you want to send (8)
C4. Providing Information Based on the Needs of Support Recipients	Devise ways to convey information reliably	Always use both oral and written means to get your message across (7)
		In information sessions, prioritize what can be clearly conveyed and make it small-scale (4)

Table 2 (*continued*)

Category	Subcategory	Code
	Provide information based on the residents' needs	Realize that you cannot get to the people you really want without creating a good environment in information sessions (4)
		Out of all the complicated information available, provide information with which the residents will sympathize (3)
		Get the residents to pick up necessary information from conversations with other residents (8)
	Provide consistency across information sources	Persist in communicating information as one voice across all information sessions (4)
		Ensure that each response given to the residents is answered as an organization (4)
	Adjust explanation methods to suit the subject	Use model-based explanations in addition to previous explanations (5)
		Transform the way you explain things if it appears that figures or oral explanations do not work for the residents (5)
C5. Continuity-focused Work to Develop Relationships with Support Recipients	Connect with support recipients	Continue even if participation guidance appears useless (8)
		Continually provide places for you to link up with evacuees (8)
	Maintain relationships with recipients	Carry on having conversations even after you have had them once (5)
		Provide space for discussion at times where the residents can attend (8)
C6. Connecting to What Residents are Thinking	Connected to the residents' thoughts	Deal with different unanswerable discussions with the residents individually (7)
		Be by the side of the residents and give the impression you will listen if they have any worries (6)
		Become familiar with subjective aspects (10)
		In individual discussions, present an image of dedication to connection and support (7)
	Standing in the shoes of the residents	Say it is fine for scared people to be scared in study groups (2)
		Select experts who do not talk with a condescending attitude in study groups (6)
		Change the way you think because you may not be explaining things well in information sessions for the residents (5)
	Not manipulating the choices of others	Do not manipulate the choices made by city residents (3)
	Support the choices of the residents	Tell the residents that they have made the right choices (9)
		No matter where you are, do not dismiss the choices made by a family (8)

Table 2 (*continued*)

Category	Subcategory	Code
B1. Professional and Empirical Knowledge Founded on Professional Ethics	Ascertain the residents' needs based on professional knowledge of the residents' occupation	I collected the knowledge I had so far and set up a consultation room (7)
		Ascertain the residents' needs from parallel perspectives (4)
		Previous experiences are helpful in my work today (8)
		I take care when listening to others because stress underlies the discussion (8)
		I gradually realized that radiation was not a problem (1)
		If I sense that there is a problem, I consider it from different angles (8)
		I identify the residents' needs through public health work (3)
	Explore what is best for the residents	I will not compromise on a plan that has been decided if I believe that it is not good for the residents, even if that results in backlash from them (5)
		Even if there are differences in perceptions, there will be no budging because I understand the principles of decontamination (5)
		I do not want to coerce the residents but occasionally I do think people must move proactively (6)
		I do not attempt to induce people to do something even if I think it is right; instead, I attempt to connect to the sway of that person's pace (3)
		I do as much as is possible within the scope of the law (5)
	Work based on professional norms	I thought back on how if doctors do not do their work from the standpoint of the residents, who will protect them? (1)
		When I was unsure, I could pivot by returning to the knowledge that I was a doctor (1)
	Awareness of one's role as a communicator	You must think in such a manner that you are pleased that the locals have come (6)
		There are still so many people experiencing hardship that you think, what if nobody did it? (8)
	A sense of duty to be helpful in one's region	I want to somehow help people experiencing hardship (8)
		I want to repeat here what I did well at the evacuation sites (8)
		My first thought was that I wanted to help the residents (7)
B2. Regional and Professional Collaboration and Cooperation with	Complementarity through cross-occupational collaboration	I convey to other organizations the information that I consider to be necessary (4)

Table 2 (*continued*)

Category	Subcategory	Code
Complementary Effects		We crossed the boundaries of our organization's vertical structures to engage laterally (4)
		It was helpful that there were people who connected certain residents who were bad at administration to us (3)
		I encourage collaboration between organizations to avoid new distrust (4)
		I am aware of information sharing across different occupations within the organization (4)
		I handled it by collaborating with public health nurses (8)
	Cooperation with the region	Support coordinators who cooperate with the region knowing the local strengths and weaknesses (8)
		We adopted a supportive approach that also involved linking up with other associations (8)
		People who are more engaged with locals than I am had great reach (6)
		We worked together on radioactivity as an administrative ward (6)
		Actions for the next step were taken by the district mayor (6)
	Engage in collaboration with experts	I remained calm no matter what those around me did because I understood the principles since I was in contact with experts (5)
		I initiated study groups on radioactivity with support from the university (10)
		I asked the reconstruction support department for help when there are things that I find difficult to communicate (10)
		I gained a greater grasp of the situation after speaking with decontamination experts (5)

"*I would go out there and play with the kids a bit, building relationships with the residents through the course of normal conversation, and then, after about a year had passed, finally started a conversation about radiation, saying something like, 'this is the thing about radiation.'*"

3.2.1.4. C4) [providing information based on the needs of support recipients]. The communicators recognized the need to transform how they explained things when providing information from the reaction from the residents and other parties. They said that they "adjusted explanation methods to suit the subject," such as model-based explanations through both oral and written means, and "devised ways to convey information reliably," such as by prioritizing clear delivery and selecting smaller venues for information sessions. They also said that they "provided information based on the residents' needs," such as by having the residents pick up necessary information from conversations among one another and providing specific details from complicated information with which they would empathize. In an environment where information regarding

Table 3
Risk communication work objectives (numbers in parentheses represent the interviewee number).

Category	Subcategory	Code
O1. Alleviating Anxiety and Stress	Reduce anxiety and stress	Rather than living in suffering, I want them to live even if just a bit more happily (10)
		I tell them that it is okay to be frightened because if you cannot say you are scared when things are scary then that builds stress (2)
		I think it is necessary to have a policy of communicating what is happening in Fukushima City based on medical knowledge to deal with concerns regarding radiation (3)
		I want people to come out with the things they want to say so they can live even just a bit more happily (10)
		Listen to concerns regarding radiation and intervene with other problems (8)
		My work here is to get the residents to vent their concerns (10)
		If scary or unpleasant things are not going away, then they should be made as light as possible (10)
		If it is going to take time for people to feel relaxed, I will need to remain by their side (10)
	Guarantee safety and deliver peace of mind	Guarantee children's safety to give parents peace of mind (7)
		It was important to move through worries one by one to get rid of them (7)
		I want children to think it was fun by guaranteeing their peace of mind (7)
		I choose decontamination to calm down the public (5)
O2. Supporting Decision-making	Support informed decision-making	The process needs to be so that the residents make choices independently (5)
		The residents decide on their own peace of mind and safety (8)
		I want the residents to decide how they are going to go forward (7)
		It would be great if the residents could make decisions that they understand one-by-one (6)
	Support the residents' decisions by standing with them	See the timing of the other person's conversation and talk in specific terms (3)
		We will stand with them because suffering is subjective (10)
		Rather than a general theory, there needs to be a place where the answers the residents want can be delivered (7)
		Pushing and encouraging the residents as they try to make decisions (7)
		Standing by the sway of that person's pace (3)
	Helping the residents become able to make	I get the residents to make their own measurements, so

Table 3 (*continued*)

Category	Subcategory	Code
	judgments after receiving information from numerous sources	they will be able to judge them and get experts to explain those measurements to them (6)
		I connect the residents to the power of selecting things by themselves in possession of information from doctors (3)
		The residents having the power to choose by themselves what they do and do not need to fear (3)
O3. Gaining Trust	Dispel distrust and create relationships of mutual trust	Persistently build relationships where the residents' misunderstandings have led to a sense of backlash against the prefecture (8)
		Communicate the purpose of your work to reduce feelings of distrust (8)
		Where there is distrust of the government, send your own messages and bring back trust (8)
		The first thing I should do when doubts are begetting doubts is to create relationships where I am trusted (4)
		First, create relationships of mutual trust where the residents can think, "they should be doing everything they can for us" (4)
	Engage with sincerity	Say that it is not possible to do things that cannot be done without taking it back for review (5)
		I always engage with children and their guardians with sincerity (7)
		I ensure to attend all information sessions to be able to see the residents' faces (5)
		In information sessions, I provide explanations that enable immediate answers without taking it back for review (5)
		I try my best to have answers to questions that are asked (4)
		Pay as many visits as possible to see the residents' faces and meet with them (3)
		Answer the residents' questions politely (3)
	Create relationships that lead onto the next	It is important in one-on-ones to make them repeatable (1)
		Certain aspects can be mutually understood by visiting and actually meeting them (3)
		Aiming for relationships to lead onto the next (1)
O4. Promoting Understanding	Provide opportunities for understanding	My work is not about persuading the residents but getting them to the starting point (1)
		By connecting them to information that can be examined, the residents begin to notice by themselves (10)
		If someone can communicate clearly, I hope that they will become a communicator as well (4)

Table 3 (*continued*)

Category	Subcategory	Code
	Gain understanding by communicating in accordance with the residents' perspectives	By explaining it, I create opportunities to understand radiation (1)
		I think you must adapt to the other person and converse through stories rather than numbers (2)
		I notice that if I do not create the right environment then I cannot get to the people I really want (4)
		If you talk in terms of stories, you can talk about things that are impossible to get to with numbers (2)
	Obtain understanding through visualization	My explanations incorporate models (5)
		Visualization is important in getting the residents to understand (5)
		I repeat explanations to the residents several times, so they will understand (5)
		I try to use things and words to communicate my point (5)
		Even if it causes criticism, I will change the way I communicate and go for it again (2)
O5. Deepening Mutual Understanding	Maintain interactive activity	The residents will not change immediately, but even so, I do it repeatedly (5)
		Relationships result by engaging repeatedly (1)
		The other person takes in what I say and then goes on to speak (5)
	Encourage mutual understanding	Even if there are clashes, you can have a discussion by making health the goal (2)
		It is important to meet and talk with the residents without delay (3)
		I absorb what the residents in a nuclear disaster are demanding through health care work (3)
		I want to respond to all individual questions that are really specific because it deepens mutual understanding (4)
	Understand each other's direction through conversation	Exchanging information in conversation allows you to understand health goals together (2)
		There are moments when you have the same conversation again when you both understand that you want to do the same things (2)
		It is important to know that you are both facing the same direction (2)
O6. Sharing Values and Empathy	Share the other's perspective and thoughts	I say that I will help them irrespective of what choice they make (7)
		I provide the other person with the necessary information but do not force them to do anything (8)
	Acknowledge the residents' sense of values	I choose experts to avoid spoiling the atmosphere of respect for the residents (6)

Table 3 (*continued*)

Category	Subcategory	Code
		I never dismiss the residents irrespective of the choices they make (8)
		I absolutely never interject or attempt to interfere because there is a reason behind the residents' concerns (6)
		I do not push them even if I think I am right (3)
	Handle diverse ideas	I handle diverse ideas by focusing on the needs of the residents (4)
	Accept the residents' conflict	I truly understand the backlash from feelings that cannot be resolved by the residents (4)
		I understand the residents' conflicting feelings, so I think that even if there is backlash you have to just let it be (5)
HO1. Returning to Normal Life	Residents to be able to live healthily and happily	I want families to be able to live happily in a place of their choosing (8)
		I want to enable them to forget about radiation (9)
		It would be great if the residents could live healthily and with a positive attitude irrespective of the choices they make (8)
		Not having to think about radioactivity (9)
		These people's lives must have stability (1)
		If the mother is healthy, the children will be able to be healthy and active as well (8)
	Residents being able to feel safe and restoring their confidence	It would be great if the residents could demonstrate safety with products from their own fields (6)
		To demonstrate safety, the only thing to do is to take measurements several times and show how the numbers are not detected (6)
		I want the residents to feel confident again about the vegetables local people produce by taking measurements on their own (6)
		The residents being able to explain to others that they feel confident and secure by confirming actual measurement values (6)
	Bring back the local community	Making local information magazines to communicate information to people who cannot attend sessions (6)
		Being able to talk normally with neighbors about radioactivity is important (6)
		Making and sharing things like local information magazines, encouraging exchange between the residents (6)
	Establish daily life	My work is not about events but cooperating to improve lives (6)
		I want it to be so that getting engaged helps one get connected to a person who can improve their life (3)

Table 3 (*continued*)

Category	Subcategory	Code
		I want the residents to pass their days in a normal manner (10)
		If a conversation is not established between the residents, then daily life will not resume (8)
		Being able to live one's normal ordinary daily life protects that person's life and above all their health, which is why I help in this manner (1)
		Quickly getting on board with the cycle of testing and returning the results to know how to live (1)
HO2. Cultivating a Wider Perspective	Encourage understanding that could be applied to risks	I want to widen the scope of people's choices (2)
		Apply the results of the risk communication here to the next separate thing (2)
		I think communicating via the online media means that many people are aware of the health risks (2)
		Understanding risk is understanding with a versatile application (2)
	Protect children's futures through radiation education support	Education implies that children's possibilities will not be curtailed (1)
		Providing children with the knowledge that will give them confidence in the future (1)
		Doing educational work out of a desire to educate children who can think seriously about the time when the earthquake happened (7)
		Pediatricians want to help so future children can make their own decisions (3)
	Communicate information to improve the health of individuals and society	Communicating health hazards is for the good of many (2)
		Irrespective of what choices they make, it is fine as long as the people are healthy (2)
		I want to make it so excessive fear of radiation does not result in increased health hazards (2)

the new understanding of radioactivity was being updated daily, the communicators persisted in communicating information across the various information sessions as one voice, thereby "providing consistency across information sources."

> "To enable us to answer each individual matter discussed in those sorts of places as an organization … while it was really a major effort to share everything and make sure we were speaking as one voice, in the end, it really helped."

3.2.1.5. C5) [continuity-focused work to develop relationships with support recipients]. The communicators were continually engaged in outreach work to "connect with support recipients," such as making themselves available for discussion with the residents when it was convenient and continually ensuring that there were places to do so. Following this, they would also "maintain relationships with the recipients" by continuing discussions and consultations.

> "I think we always have to provide a good environment. Stuff to do with notifications and flyers too … When they are trying to proceed at some
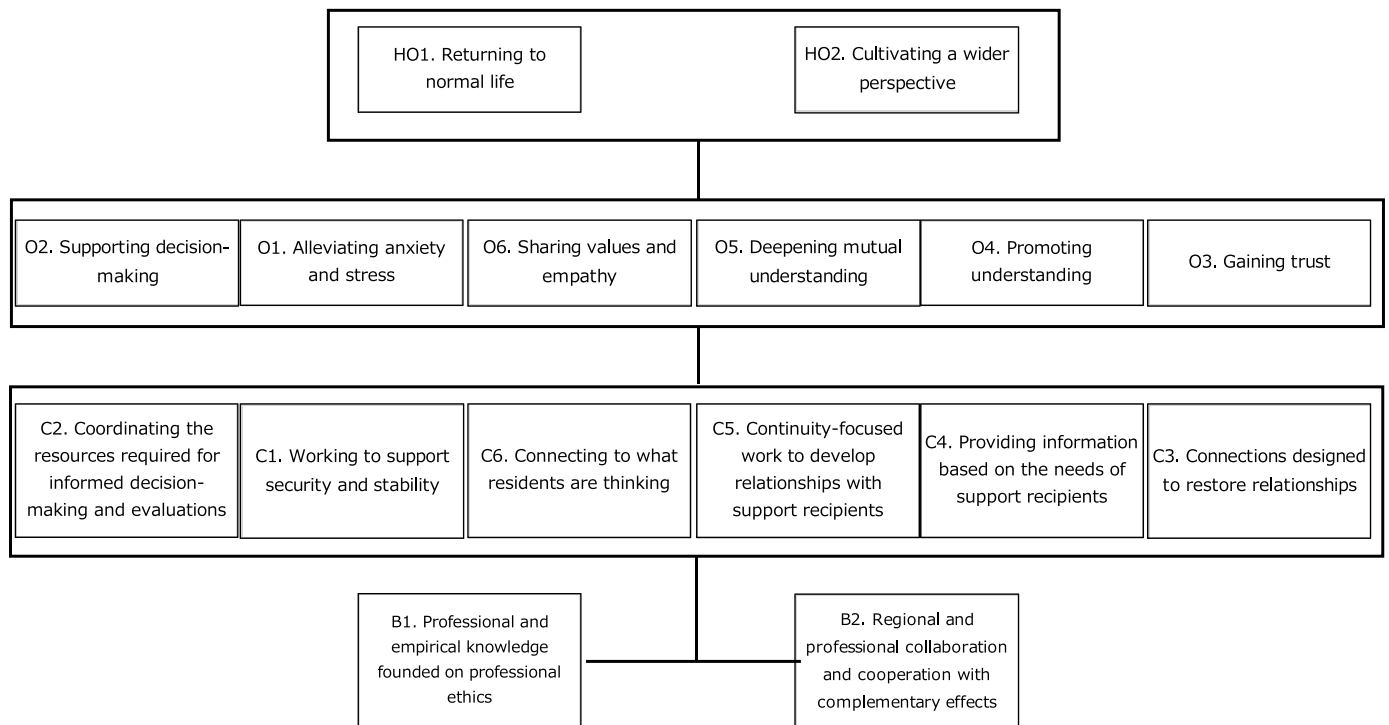
Fig. 2. Overview of risk communication work. Details of the numbers and words in the figure correspond to Tables 2 and 3, respectively. The placement of the subcategories indicates the strength of the correspondence with the higher categories (category numbers are not in order).

sort of rhythm, I really think we need to keep on making it so that we are always open."

3.2.1.6. C6) [connecting to what residents are thinking]. The communicators mentioned that they became "connected to the residents' thoughts" while responding to individual discussions where the residents had no answers. The study groups emphasized the importance of "standing in the shoes of the residents" when they invited experts. They also did "not manipulate the choices of others" and, in so doing, avoided dismissing the judgments of residents. By occasionally conveying to the residents that their choices were the right ones, they "supported the choices of the residents."

"Because it was a time when all (the residents) were downcast and anxious, I felt in the end like I was really having different discussions with each person; they remain (here) but I offer my understanding to the pain and other feelings of the residents. There is no answer."

3.2.2. Foundation/background for risk communication work

3.2.2.1. B1) [professional and empirical knowledge founded on professional ethics]. The communicators "ascertained the residents' needs based on the professional knowledge of the residents' occupation" to more effectively intervene and gain a good grasp of needs from a multilateral perspective, and "explored what is best for the residents." As this continued, on occasions when the communicator was unsure of what to do in their work, they would make judgments that pivoted around their "work based on professional norms" and continued with their work. They had an "awareness of their role as communicators" and "a sense of duty to be helpful in their regions," in that these roles had to be performed by somebody for the sake of those experiencing hardship. These narratives were considered more as the basis and background supporting their work than being about the work of risk communication itself.

"Whenever I was unsure about what I was doing, I could always go back to the place of being a doctor … If a doctor keeps doing their job in a way that is not favoring the interest of the local residents, then, in the end, who will protect them?"

3.2.2.2. B2) [regional and professional collaboration and cooperation with complementary effects]. The communicators were aware of multidisciplinary information sharing in various settings of risk communication. There was "complementarity through cross-occupational collaboration," which was achieved through inter-organizational collaborations where seemingly necessary information was conveyed to other organizations, and cross-occupational collaboration—for example, providing connections to public health nurses in resident interventions. Coordinators who organized support for evacuated residents worked to implement "cooperation with the region" through initiatives introduced with the region, and "engaged in collaboration with experts," for example by receiving support from universities in radioactivity study groups and requesting the government's support with aspects that were difficult to communicate. As with [B1], these narratives were considered the basis and background for supporting risk communication work.

"In addition to taking measurements, the experts listened to the same questions countless times and answered them carefully and honestly, which we found very reassuring … We were grateful for the assistance we received."

3.3. Risk communication work objectives

3.3.1. Communicator objectives

3.3.1.1. O1) [alleviating anxiety and stress]. The communicators worked continuously to "reduce anxiety and stress" among the residents as well as "guarantee safety and deliver peace of mind," such as by publicizing the implementation of radiation protection measures from

an early stage and other accompanying measures as well as engaging in individual discussions on anxiety countermeasures.

"It was like ... as far as it was possible, I wanted (the residents) not to be suffering as they went about their lives, I wanted them to live just a bit more happily ... I wanted them to have a light heart as much as possible—for the weight on their shoulders to be lifted."

3.3.1.2. O2) [supporting decision-making]. The communicators worked in various ways to "help the residents become able to make judgments after receiving information from numerous sources," such as by having them make their own measurements that would then be explained by experts, or hosting radiation measurement and study sessions for the residents to obtain information from numerous perspectives, thereby "supporting informed decision-making." They also created an environment and held individual consultations to "support the residents' decisions by standing with them," thereby encouraging the residents' individual decisions and adopting an attitude of becoming connected to their subjective troubles.

"I guess it could be seen as giving someone a helpful push ... I push and encourage that person toward the decision they are trying to make."

3.3.1.3. O3) [gaining trust]. The communicators hoped to "dispel distrust and create relationships of mutual trust," by communicating their work objectives to reduce feelings of distrust, and gradually create relationships where the residents' misunderstandings led to a sense of backlash. They worked to "engage with sincerity" and "create relationships that led onto the next" when it was difficult to address certain aspects in information sessions for the residents without glossing over the truth, responding carefully to the residents' questions, and visiting them as often as possible and seeing their faces.

"I went to nearly all the information sessions by myself. I did not like how conversations would be different when multiple people went ... When other people went, they would come back with something and it was not that I had nothing, but I avoided it as much as possible."

3.3.1.4. O4) [promoting understanding]. The communicators aimed to "provide opportunities for understanding." They changed how they communicated and re-transmitted information with the approach of "obtaining understanding through visualization," such as by attempting communication using words as well as materials. They worked to help the residents "gain understanding by communicating in accordance with the residents' perspectives." For example, one cannot reach the necessary people without creating a good environment for it, and when one talks using stories, one can discuss aspects that go beyond numerical figures.

"I thought to myself, maybe this explanation is bad ... I realized I was explaining this badly. Some beads caught my eye in a 100-Japanese-Yen shop, and I thought that I could use them like this and created a model of a house with a Tokyo Banana box, sewing on the beads here and there. I created two and made a blue flexible container bag. I started my explanation by asking, out of this one and that one, which do you think is good?"

3.3.1.5. O5) [deepening mutual understanding]. To help "maintain interactive activity," communicators repeated their explanations to residents multiple times and practiced an approach of responding to all individual questions posed in the information sessions to "encourage mutual understanding." They also maintained ongoing engagement to "understand each other's direction through conversation" through repeated dialogue, and so on.

"There are other residents there as well, so try to speak with the teacher afterwards ... But you know, that deepens understanding, and so I have no option but to accept it all ..."

3.3.1.6. O6) [Sharing values and empathy]. The communicators were conscious of "acknowledging the residents' sense of values" to "share the other's perspective and thoughts," such as by refraining from imposing their own opinions even when they believed that they were correct. They also worked to focus on the needs of their subjects and "handle diverse ideas." In addition, when the residents had differing opinions, they "accepted the residents' conflict" by acknowledging that there was nothing that could be done, because they understood each other's conflicting feelings.

"Even though I had the tendency to think that my information was more accurate ... instead of going against what they were saying and pushing a certain line, I did it bit by bit, trying not to damage this person's sense of values because it was a stage of their anxieties and part of what they expressed in words was hidden in their heart ..."

3.3.2. Higher objectives of communicators

3.3.2.1. HO1) [returning to normal life]. The communicators stated that they wanted the "residents to be able to live healthily and happily," and worked hard on hosting study groups and resident information sessions. Further, a few communicators in this group adopted an attitude of supporting the residents' choices, irrespective of what they were. They also worked to make sure that their radiation measurements afforded opportunities for the "residents to be able to feel safe and restore their confidence." These communicators also spoke about how it was important to establish conversations between the residents as part of everyday life and for the neighbors to talk normally about radiation and to encourage interactions between the residents to "bring back the local community." Moreover, they worked to improve the residents' living environments, for example by building early-stage inspection systems and hosting lectures to "establish daily life" for them.

These narratives were categorized as being part of higher objective 1 (HO1) because they are powerful indicators of the communicator's sense of values, which strongly determines the directionality rather than the specific objectives of their communication practice.

"Measuring things before our eyes like this meant that at the very least local people were able to have confidence again in their vegetables, and you ca not explain things to other people if you do not know it with confidence in yourself. Because of this, I think you have to be able to say to yourself that it is safe, so I thought they should be able to do that."

3.3.2.2. HO2) [cultivating a wider perspective]. A few communicators stated that they attempted to "encourage understanding that could be applied to risks" to widen the scope of choices available to the residents that could be applied versatilely in dealing with the various risks caused by the Fukushima nuclear disaster. They also attempted to communicate information as per the objectives, such as online communication targeting a wide area or through the medium of mass media to "communicate information to improve the health of individuals and society." Moreover, they were involved in educational work with children and schools during different projects to "protect children's futures through radiation education support."

These narratives suggest that the communicators did not merely confine their work to the locus of their practice within Fukushima Prefecture, but aimed for the general public to gain a wider perspective on risks through the prism of post-nuclear disaster experience. Therefore, this sense of objectives is inherent in the communicators and can thus be considered a higher objective that steers various communication

objectives.

> "*Rather than this being about radiation, I think the important thing is that people do not become unhealthy by going out of their way to avoid radiation. For example, if they do not go outside or do not eat mushrooms or fish, doing these things will mean not getting enough vitamin D or calcium—if you do not go outside then you are not getting exercise and you are not getting any daylight. All of these are health risks, and I want to make sure that people are not risking their health through an excessive fear of radiation.*"

4. Discussion

In this study, we employed a qualitative method to survey communicators regarding their risk communication work related to the various health risks that arose in the aftermath of the Fukushima nuclear disaster in order to clarify their work and its objectives. We took measures to ensure that the communicators in the study sample were diverse in expertise, occupation, scope, and locality. The categories extracted from the above reflect the narratives of multiple interviewers, thereby suggesting that the content of risk communication and its objectives reached theoretical saturation. In addition, this study is significant in terms of integrating and analyzing multiple practices.

4.1. Features of risk communication work

The analysis of the communicators' work regarding the various health risks that arose following the Fukushima nuclear disaster resulted in the extraction of the following categories: [C1–C6]. With regard to the foundation and background of their work, the following foundation/background categories were extracted: [B1] and [B2].

A review paper on risk communication by medical staff after the Fukushima nuclear disaster [9] found that risk communication work involved cross-occupational collaboration and explained the content of health surveys, measurements, and consultations with patients regarding their radiation exposure levels and general health promotion. Other reports show that they provided and shared scientific information and offered counseling and decision-making support for a background of concerns regarding radiation exposure and psychosocial issues [10,12,24–27]. The eight categories listed above showed consistency with these activities, thereby confirming that the content of the communicators' work extracted through the interviews was valid.

The work to "take the residents' concerns seriously" and "respond to individual concerns" in [C1] is believed to have been undertaken because concern regarding radiation exposure following a nuclear disaster is an issue that relates to various health risks, including psychological trauma, stigma, and discrimination [2,5,6].

The work done by the communicators to "be vigilant in allowing the residents to make decisions alone where possible" and "connect the people and information required to make judgments and evaluations" in [C2] supports the right to self-determination of the individual in spreading democratic values and is considered an important aspect of the work done in risk communication [28]. Since the Fukushima nuclear disaster, the residents have been provided with substantial information that they would not have otherwise encountered in their everyday lives. Making decisions while comprehending and predicting the reality of their situation would have presented a psychological burden for the residents and created a difficult experience for them to overcome alone. With various options available, monitoring choices while coordinating resources encourages the aforementioned ability to make one's own choices and implies an impact that reduced the psychological burden, thereby suggesting that it is an important aspect of individual decision-making.

The work done to "engage frankly as a fellow human" and "answer the residents' questions in a reliable manner" in [C3] and to "provide information based on the residents' needs" as well as "adjust explanation methods to suit the subject" in [C4] suggested an approach of prioritizing residents' intentions and was strongly consistent with the ideal of risk communication, which emphasized interaction [17]. Further, with regard to information provision, communicators also provided information immediacy in "holding information sessions where questions would be responded to at the time of asking." In this respect, risk communication is conducted with the objective of responding immediately to the residents' dissatisfaction with delayed information provision or where answers cannot be obtained. Conversely, the accuracy of the information in typical risk communication scenarios has been highlighted [29], and "providing consistency in information sources" was extracted as a factor in this study. Communicators working on risk communication following the Fukushima nuclear disaster placed significant importance on how they provided information regarding immediacy and consistency, against the backdrop of their concern about restoring relationships with the residents.

In [C5] and [C6], the communicators said they "stood in the shoes of the residents," in that they would select experts to study groups who did not speak with a condescending attitude. Researchers in risk communication have emphasized the need to go beyond the merely providing scientifically accurate information to ensure citizen-centered communication and higher levels of engagement, where both communicators and recipients of the information are involved in social learning [19,29]. Similar to the previous study, it appears that this process was considered in risk communication work following the Fukushima nuclear disaster.

[B1] reflects the sense of professionalism and professional norms fleshed out by the experience and expertise of the communicators, all of whom came from varied backgrounds. Moreover, [B2] demonstrates how cooperation has complementary effects on a variety of health risks across a wide region. The professionalism, collaboration, and cooperation demonstrated in these two categories are essential functions of daily practices and important foundational premises for promoting communication work. That is why, as depicted in Fig. 2, these two categories were considered to have the effect of supporting and facilitating the other six categories.

4.2. Risk communication objectives

An analysis of the objectives underlying the various health risk communications that arose in the aftermath of the Fukushima nuclear disaster resulted in the extraction of the following objectives of risk communication work [O1–O6]. Further, the following were the higher objectives steering the various communication objectives: [HO1] and [HO2]. Renn highlighted that the ultimate goal of risk communication is to assist stakeholders and the public at large in understanding the rationale of a risk-based (risk-informed) decision, and to arrive at a balanced judgment that reflects the factual evidence with respect to the matter at hand regarding their own interests and values [30]. The current objectives of risk communication, which is regarded as an interactive process, were similar to [O1–O6].

However, [HO1] and [HO2], which reflect the communicators' inherent value systems and steer communication objectives, have not been previously reported. These are the higher objectives of risk communication extracted in this qualitative research study to understand and ascertain in an exploratory and integrated fashion the meaning of multiple practices of risk communication.

Further, it can be considered that "reducing anxiety and stress" in [O1] for the residents is intended to reduce their psychological health risks. It is natural to have concerns over radiation exposure after a nuclear disaster, and it is meaningful in that one has countermeasures to reduce exposure, but it is also true that excessive anxiety leads to psychological stress [21]. While the risk of radiation exposure in the aftermath of the Fukushima nuclear disaster was limited, in circumstances where there is a remarkable risk of psychological distress [31], communicators can be vindicated in working on risk communication to

reduce stress and concerns regarding radiation exposure.

Most guidelines and proposals regarding risk communication stipulate [O4] as one of their aims [17,18]. It is difficult for residents to comprehend radiation exposure risks [32]. Following the Fukushima nuclear disaster, communicators promoted understanding through means that considered the listener's response by "obtaining understanding through visualization," and so on.

[O3] influences residents' perceived risks as well as perceived benefits and impacts their acceptance of risk and behavior [33,34]. In an environment in which deep distrust existed toward the government regarding the handling of radiation in the aftermath of the Fukushima nuclear disaster [35], communicators built trust to implement more effective risk communication.

Concerning [O2], [O5], and [O6], shared decision-making (SDM) has recently attracted attention in the field of health care for medical professionals and patients to make and consent to decisions [36]. The crucial aspect of SDM is that patients and medical professionals agree on treatment options as they share information and take mutually agreed steps [36]. The subcategories extracted in this study include "sharing the other's perspective and thoughts," "acknowledging the residents' sense of values," and "handling diverse ideas" in [O6]; "maintaining interactive activity," "encouraging mutual understanding," and "understanding each other's direction through conversation" in [O5]; and "supporting informed decision-making," "support the residents' decisions by standing with them," and "helping the residents become able to make judgments after receiving information from numerous sources" in [O2], which demonstrated similarity to the ideals of SDM.

In addition, the survey participants working in the highly specialized occupations, such as doctors and nursery teachers (Participants 1, 2, and 7) exhibited remarkable adherence to [HO2]. In this regard, a report has argued that it is important to develop residents' risk literacy [37]. Kanda et al. reported on the mental state of information recipients determined via consultation services conducted through a risk communication work over the five months following the Fukushima nuclear disaster [38]. For a vast majority of participants, mental distress was reduced after the consultation; however, a minority faced increased mental distress and a few had attached so much importance to dealing with radiation that their health was damaged. Science education requires individuals to possess sufficient literacy to consciously judge whether other risks might increase when reducing radiation levels. [HO2] comprises the subcategories "encouraging understanding that could be applied to risks," "protecting children's futures through radiation education support," and "communicating information to improve the health of individuals and society." It is a higher objective that aims to change the public's perspective of risks, not only those from nuclear disasters, in the future. Previous studies revealed that the sharing of such a wider perspective among information recipients might be a basic condition for effective communication in the aftermath of a nuclear disaster [37,39].

Further, communicators engaged in a range of activities with the objective of [HO1]. Since the Fukushima nuclear disaster, the lives of the affected residents in the prefecture have entirely changed. Within the context of these unavoidable changes, the narratives of "it would be great if the residents could demonstrate safety with products from their own fields," "being able to talk normally with neighbors about radioactivity is important," "being able to forget about radiation," and "my work is not about events but about cooperating to improve lives" suggest that communicators always perceive the Fukushima nuclear disaster within the context of daily life.

These communicators' perspectives can be summarized as accommodating changes and works that are oriented toward restoration. They are presumed to be narratives of the communicators' higher objective of [HO1]. With regard to the subcategories of "bringing back the local community" and "establishing daily life" in [HO1], a few researchers believe that community resilience is more effectively facilitated in regions with developed social capital [40]. The higher objective of communicators with a strong awareness of [HO1], such as to "bring back the

local community" or "establish daily life," demonstrates an approach that places importance on the return to social capital that facilitates community resilience.

As previously stated, two categories for the content of risk communication work—[B1] and [B2]—serve as important bases in advancing communication work and can be summarized as categories that support and facilitate the other six categories ([C1–C6]). The six areas of work done by communicators are considered to correspond to the risk communication objectives of [O1–O6]. The objective of [HO1] was understood to be adapting to changes after the Fukushima nuclear disaster and ultimately to achieve restoration, while the goal of [HO2] was understood to be achieving future risk literacy broader than just the Fukushima nuclear disaster. Further, [HO1] and [HO2] could be summarized as comprehensive concepts that steer the six objectives ([O1–O6]) of communication work (Fig. 2).

4.3. Implications for risk communication

In this study, we extracted two supporting foundations/background categories for risk communication ([B1] and [B2]), six main types of work content ([C1–C6]) and objectives ([O1–O6]), and two steering objectives ([HO1] and [HO2]). The structuralized content and objectives of risk communication work after the Fukushima nuclear disaster in this study are useful in several respects regarding its implementation. The objectives of risk communication are diverse and differ depending on the practitioner. While their legitimacy is reliant on social judgment, legitimacy is rarely stated explicitly [21]. The findings of this study—in particular, the extraction of higher objectives that determine specific objectives and their direction in risk communication practice—encourages risk communication practitioners to reconsider the fundamental sense of objectives underlying their work and its legitimacy. They are also helpful to the social debate on the legitimacy of risk communication objectives. Further, the objectives categorized in this study could be used to build indicators to evaluate the success of risk communication. Thus, the findings of this study can be expected to lead to a careful consideration of risk communication objectives and drive social debate on its legitimacy and the evaluation of its effects, thereby contributing to the establishment of effective risk communication practices.

This study has several limitations. First, the study considers risk communication undertaken following the Fukushima nuclear disaster and includes elements such as "Returning to Normal Life" and "Alleviating Anxiety and Stress" that often become a concern, especially in the case of a nuclear disaster. Therefore, caution is required when applying it to other events (nuclear disasters with significant health risks from radiation exposure, other man-made/natural disasters, etc.). Second, it is important to note the aspects of chronological changes in communication work content and objectives after the Fukushima nuclear disaster. The objectives of risk communication can be assumed to change depending on the period involved, and this study did not generalize the objectives and content of work for each period. Third, regional differences, such as evacuation conditions and radiation contamination, were not included in the analysis. This warrants further detailed investigations of regional differences in the future. Moreover, it is prospective that studies must be conducted to examine the content of work involved in risk communication and its objectives in areas other than a nuclear disaster as well as to consider risk communication in various events and time phases.

5. Conclusion

In this study, interviews were conducted with communicators following the Fukushima nuclear disaster to structuralize the content of their work and its objectives. The main findings of this study are as follows.

With regard to the content of risk communication work, the following categories were extracted: [working to support security and

stability], [coordinating the resources required for informed decision-making and evaluations], [connections designed to restore relationships], [providing information based on the needs of support recipients], [continuity-focused work to develop relationships with support recipients], and [connecting to what residents are thinking]. Further, having [professional and empirical knowledge founded on professional ethics] as well as [regional and professional collaboration and cooperation with complementary effects] are important foundations that support and facilitate the work.

With regard to risk communication objectives, [alleviating anxiety and stress], [supporting decision-making], [gaining trust], [promoting understanding], [deepening mutual understanding], and [sharing values and empathy] were extracted as categories; the new categories of [returning to normal life] and [cultivating a wider perspective] were identified as higher objectives.

The objectives of risk communication are diverse, and its success can be judged by indicators that reflect the objectives of the communicators. In addition, the validity of the objectives and effects must be discussed from a social normative viewpoint. The findings of this study can be expected to help establish effective risk communication practices by carefully considering the objectives of risk communication, the social debate regarding legitimacy, and an evaluation of its effects.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: There are no financial competing interests. Some interviewees in this study are colleagues of authors and/or have experiences of collaborative researches with authors.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2020.101899.

References

[1] United Nations Scientific Committee on the Effects of Atomic Radiation, Sources, Effects and Risks of Ionizing Radiation, UNSCEAR 2013 Reports to the General Assembly with Scientific Annexes, United Nations, New York, 2014.

[2] M. Maeda, M. Murakami, M. Oe, Fukushima Nuclear Disaster: Multidimensional Psychosocial Issues and Challenges to Overcome Them, Encyclopedia of Environmental Health, second ed., 2019, https://doi.org/10.1016/B978-0-12-409548-9.10981-9.

[3] T. Ohira, H. Nakano, M. Nagai, Y. Yumiya, W. Zhang, M. Uemura, A. Sakai, S. Hashimoto, Changes in cardiovascular risk factors after the Great East Japan Earthquake, Asia Pac. J. Publ. Health 29 (2017) 47s–55s.

[4] D.K. Ebner, M. Ohsawa, K. Igari, K.H. Harada, A. Koizumi, Lifestyle-related diseases following the evacuation after the Fukushima Daiichi nuclear power plant accident: a retrospective study of Kawauchi Village with long-term follow-up, BMJ Open 6 (2016), e011641.

[5] Y. Suzuki, Y. Yabe, S. Yasumura, T. Ohira, S. Niwa, A. Ohtsuru, H. Mashiko, M. Maeda, M. Abe, Psychological distress and the perception of radiation risks: the Fukushima health management survey, Bull. World Health Organ. 93 (2015) 598–605.

[6] T. Sawano, Y. Nishikawa, A. Ozaki, C. Leppold, M. Tsubokura, The Fukushima Daiichi Nuclear Power Plant accident and school bullying of affected children and adolescents: the need for continuous radiation education, J. Radiat. Res. 59 (2018) 381–384.

[7] T. Tiefenbach, F. Kohlbacher, Happiness in Japan in times of upheaval: empirical evidence from the national survey on lifestyle preferences, J. Happiness Stud. 16 (2015) 333–366.

[8] M. Murakami, A. Kumagai, A.N. Stojarov, M. Tsubokura, Radiation is not a political tool, Science 366 (2019) 581–582.

[9] M. Murakami, A. Sato, S. Matsui, A. Goto, A. Kumagai, M. Tsubokura, M. Orita, N. Takamura, Y. Kuroda, S. Ochi, Communicating with residents about risks following the Fukushima nuclear accident, Asia Pac. J. Publ. Health 29 (2017) 74s–89s.

[10] T. Shimura, I. Yamaguchi, H. Terada, E. Robert Svendsen, N. Kunugita, Public health activities for mitigation of radiation exposures and risk communication challenges after the Fukushima nuclear accident, J. Radiat. Res. 56 (2015) 422–429.

[11] R. Ando, Measuring, discussing, and living together: lessons from 4 years in Suetsugi, Ann. ICRP 45 (2016) 75–83.

[12] J. Lochard, The genesis of the ICRP dialogue initiative, Ann. ICRP 45 (2016) 7–13.

[13] T. Iimoto, H. Fujii, S. Someya, H. Matsuzawa, Y. Yanagawa, K. Kunii, Cooperation process between a local government and experts in official voluntary decontamination of environmental radioactivity, J. Radiat. Res. 59 (2018) ii48–ii53.

[14] Y. Yumiya, A. Goto, M. Murakami, T. Ohira, R.E. Rudd, Communication between Health Professionals and Community Residents in Fukushima: A Focus on the Feedback Loop, Health Communication, 2019, pp. 1–9, https://doi.org/10.1080/10410236.10412019.11625004.

[15] T. Schneider, M. Maître, J. Lochard, S. Charron, J.-F. Lecomte, R. Ando, Y. Kanai, M. Kurihara, Y. Kuroda, M. Miyazaki, W. Naito, M. Orita, N. Takamura, K. Tanigawa, M. Tsubokura, T. Yasutaka, The role of radiological protection experts in stakeholder involvement in the recovery phase of post-nuclear accident situations: some lessons from the Fukushima-Daïchi NPP accident, Radioprotection 54 (2019) 259–270.

[16] Science Council of Japan Committee, Committee of Clinical Medicine -Radiological Protection and Risk Management Sectional Committee-: Enhancement of Radiological Health Risk Science Education Including Compulsory in Medical Education (Translated by the Authors) Rinsho Igaku Iinkai Houshasenbougo Risk Management Bunkakai: Igaku Kyoiku Niokeru Hisshuka Wo Hajimetosuru Houshasen No Kenkou Risk Kagakukyoiku No Jujitu, 2014 (in Japanese), http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-22-t197-3.pdf. (Accessed 25 December 2019).

[17] National Research Council, Improving Risk Communication, National Academy Press, Washington D.C., 1987.

[18] J. Persensky, S. Browde, A. Szabo, L. Peterson, E. Specht, E. Wight, Effective risk communication: the Nuclear Regulatory Commission's guidelines for external risk communication. https://www.nrc.gov/docs/ML0406/ML040690412.pdf, 2004. (Accessed 25 December 2019).

[19] O. Renn, Risk communication: insights and requirements for designing successful communication programs on health and environmental hazards, in: R.L. Heath, H. D. O'Hair (Eds.), Handbook of Risk and Crisis Communication, Taylor & Francis, Oxford, UK, 2010, pp. 81–99.

[20] D.A. Zipkin, C.A. Umscheid, N.L. Keating, E. Allen, K. Aung, R. Beyth, S. Kaatz, D. M. Mann, J.B. Sussman, D. Korenstein, C. Schardt, A. Nagi, R. Sloane, D. A. Feldstein, Evidence-based risk communication: a systematic review, Ann. Intern. Med. 161 (2014) 270–280.

[21] M. Murakami, M. Tsubokura, Evaluating risk communication after the Fukushima disaster based on nudge theory, Asia Pac. J. Publ. Health 29 (2017) 193s–200s.

[22] K. Honda, Y. Igarashi, M. Murakami, Analysis of risk communication activity contents and objectives after the Fukushima Daiichi nuclear power plant accident (translated by the authors) *Fukushima Daichi Genshiryoku Hatudensho jiko ikoni nasareta risk communication no katudou naiyou to mokuteki no kaiseki,* in: Proceedings of the 8th Annual Meeting of the Radiological Nursing Society of Japan, 2019, p. 146 (in Japanese).

[23] M. Murakami, Report on Research Project "Systematization of Evaluation Indicators Used to Measure Effectiveness of Risk Communication Activities and Their Application to interventions.", 2019 (in Japanese), http://www.env.go.jp/chemi/chemi/rhm/R0104e_3.pdf. (Accessed 25 December 2019).

[24] S. Midorikawa, K. Tanigawa, S. Suzuki, A. Ohtsuru, Psychosocial issues related to thyroid examination after a radiation disaster, Asia-Pac, J. Public Health 29 (2017) 63s–73s.

[25] N. Takamura, Y. Taira, K. Yoshida, K. Nakashima-Hashiguchi, M. Orita, S. Yamashita, Communicating radiation risk to the population of Fukushima, Radiat. Protect. Dosim. 171 (2016) 23–26.

[26] Y. Kuroda, Current state and problems of radiation risk communication: based on the results of a 2012 whole village survey, PLoS Curr. Disasters 9 (2017).

[27] M. Tsubokura, Y. Nabeshima, M. Murakami, T. Nemoto, T. Kambe, S. Nonaka, Y. Shimada, Y. Kobashi, A. Ozaki, T. Oikawa, Usefulness of the whole-body counter for infants and small children (BABYSCAN) as a risk communication tool after the Fukushima Daiichi nuclear power plant incident, Proc. Japan Acad. Ser. B 96 (2020) 70–78.

[28] B. Fischhoff, J. Kadvany, Risk: A Very Short Introduction, Oxford University Press, Oxford, United Kingdom, 2011.

[29] B. Fischhoff, Risk perception and communication unplugged: twenty years of process, Risk Anal. 15 (1995) 137–145.

[30] O. Renn, Four questions for risk communication: a response to Roger Kasperson, J. Risk Res. 17 (2014) 1277–1281.

[31] M. Murakami, M. Tsubokura, K. Ono, M. Maeda, New "loss of happy life expectancy" indicator and its use in risk comparison after Fukushima disaster, Sci. Total Environ. 615 (2018) 1527–1534.

[32] R. Kanda, Risk Communication in the field of radiation, J. Disaster Res. 9 (2014) 608–618.

[33] V.H.M. Visschers, M. Siegrist, How a nuclear power plant accident influences acceptance of nuclear power: results of a longitudinal study before and after the Fukushima Disaster, Risk Anal. 33 (2013) 333–347.

[34] Y. Takebayashi, Y. Lyamzina, Y. Suzuki, M. Murakami, Risk perception and anxiety regarding radiation after the 2011 Fukushima nuclear power plant accident: a systematic qualitative review, Int. J. Environ. Res. Publ. Health 14 (2017) 1306.

[35] C. Hobson, Rebuilding Trust after Fukushima. Fukushima Global Communication Programme Working Paper Series No.4, United Nations University Institute for the Advanced Study of Sustainability, Tokyo, 2015.

[36] C. Charles, A. Gafni, T. Whelan, Shared decision-making in the medical encounter: what does it mean? (Or it takes, at least two to tango), Soc. Sci. Med. 44 (1997) 681–692.

[37] T. Kusumi, R. Hirayama, Y. Kashima, Risk perception and risk talk: the case of the Fukushima Daiichi nuclear radiation risk, Risk Anal. 37 (2017) 2305–2320.

[38] R. Kanda, S. Saigusa, H. Yonehara, K. Sakai, 2S1-A2: literacy for understanding and reducing radiation risk, in: Proceedings of the Annual Meeting of Japan Society for Science Education, vol. 35, 2011, pp. 3–4 (in Japanese).

[39] N. Machida, M. Murakami, Y. Takebayashi, A. Kumagai, T. Yamaguchi, Perceived risk and demands for countermeasures against diabetes and radiation in Fukushima after the nuclear accident: effects of self-rated risk trade-off view and provision of risk information, Int. J. Disaster Risk Reduct. 49 (2020) 101671.

[40] D.P. Aldrich, Building Resilience: Social Capital in Post-disaster Recovery, Chigago, the United States, University of Chicago Press, 2012.