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Lessons being learned between the Covid-19 pandemic and radiological emergencies: report from experts' discussions

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Abstract

In order to examine what lessons radiological emergency management may offer to the Covid-19 pandemic management and vice versa, a series of three online webinars were conducted with leading experts, scholars and practitioners from a wide range of disciplines essential for emergency management and long-term risk governance. The first webinar debated the lessons we are learning from the Covid-19 pandemic for radiological risk communication, the second explored issues around longer-term outcomes of a crisis and how to balance these with short-term actions whilst the third focused on the key challenges of the 'transition phase', using lessons learned from Chernobyl (1986) and Fukushima Daichii (2011) accidents. This paper reviews the discussion and provides valuable lessons for the radiation protection community. Results of the discussion indicated that: i) non-radiological and non-epidemiological consequences of emergencies, e.g. psychological (mental health), societal and economic, should not be underestimated; ii) multidisciplinary expertise is imperative for communication efforts and for effective emergency management, including decision-making in the application of protective measures; iii) stakeholder engagement, including the involvement of the potentially affected population, should be encouraged from an early stage and iv) trust is increased if policy-makers and main science agencies show a unified voice.

Keywords: Covid-19 pandemic, Fukushima and Chernobyl accidents, emergency management, radiological risks

Introduction

The message "*you can't see, smell, or taste it, but it may be a problem*…" in relation to Covid-19 has many similarities to the messages delivered by experts working in radiation protection. The research platform for social sciences and humanities in ionizing radiation research – SHARE - organised a series of online events during the first peak of the Covid-19 pandemic, between 26 March and 13 May 2020, with leading experts to explore cross-overs and lessons learned between the Covid-19 pandemic and radiological emergencies (see Appendix 1 for the list of panellists). Challenges from fields such as risk communication, crisis management, epidemiology and health, policy-making, science studies, economics and statistics were covered over 3 webinars. At each event, a panel of experts presented key lessons, answered questions from the audience and gave suggestions of areas for further research relevant to nuclear or radiological emergency management.

Lessons from past radiological emergencies demonstrate that at the outset of the emergency response, the potential societal impact of the accident is often underestimated (Tomkiv et al. 2020). Non-radiological consequences, for instance, psychological distress, alcoholism, unsafe sexual practice, insomnia state, misemployment, stigma, economic downturn or human relations problems may have a broader impact on society than radiological consequences (Maeda, 2017; Bromet, 2012; Bromet & Havenaar, 2007; van Deventer

et al., 2012). Public communication, although one of the most challenging aspects of emergency management, can mitigate some of these consequences (Ng and Lean 2012, Perko 2016, Perko and Martell 2020).
Several studies report the following societal aspects related to nuclear emergency management:
- nuclear safety authorities are often not able to respond to the higher information needs from the public (Mays et al. 2016);
- differences in expert opinion expressed in public, particularly on health effects (Tomkiv et al. 2020) as well as contradictory information (Perko, Turcanu and Carlé 2012) cause a lot of uncertainties and suspicions;
- emergency communication plans do not sufficiently consider social media and do not address emerging citizen science initiatives (Perko et al. 2015, Wendling, Radisch and Jacobzone, 2013);
- public communication response is different even in neighbouring countries despite similarities in the radiological risks involved (Gallego et al. 2017);
- different countries apply different transparency arrangements (NTW 2015, Perko, Martell and Turcanu 2020);
-stakeholders are not aware of existing emergency response plans and how decisions could influence their lives (OECD/NEA 2017);
- stakeholder engagement should be broadened – in terms of stakeholders and forms of engagement, and strengthened – in terms of sustainability and impact (Geysmans et al. 2020).

All of the above provided the background for the first discussion organised with panellists, which was dedicated to lessons from the Covid-19 pandemic for radiological risk communication.

Balancing short-term action and longer-term outcomes in emergency management is challenging. As noted by Turcanu et al. (Turcanu, Sala et al., 2020) society's vulnerability to disasters is not only determined by their magnitude or unpredictability, but also the manner in which people and institutions respond to these events. Geysmans et al. (Geysmans et al., 2020) found that response to, and recovery from, radiological emergency is characterised by a complex and tangled web of provisions and actions, in which many stakeholders may have a role or interest. Strengthening participation of stakeholders in emergency response and recovery post-accident may increase the trust in the responsible authorities and lead to improved compliance with protective actions (Perko, Martell and Turcanu 2020). International and European legal requirements in the field of radiation protection, radiation safety and emergency preparedness and response, call for increasing levels of stakeholder engagement. For instance, the Basic Safety Standards Directive (EC 2014) requires consultation with stakeholders and their involvement in decision-making in existing exposure situations, including post-accidental situations (Perko, Martell and Turcanu 2020). It is advised that in an optimal situation stakeholders balance short-term action and longer-term outcomes. Since this is more wishful thinking than practice (Turcanu et al. 2020, Perko and Martell 2020), the second panel discussion explored options on how to find this balance.

The ultimate goals of the transition phase of any emergency management are to restore social and economic activity in the affected areas to whatever extent possible, as well as to mitigate the impacts of the emergency and transition phase on the population, infrastructure and the environment (Schneider et al. 2016). These goals present significant challenges not only to affected populations, but also to the organisations responsible for the emergency management and recovery activities in countries directly or indirectly affected by the event. The third panel discussion highlighted key challenges for managing the transition phase and offered lessons from Chernobyl and Fukushima Daichii accidents to the Covid-19 pandemic management.

This summary provides a review of key topics discussed and some of the main insights offered. Full recordings, lists of panel members and their talk titles, are available via the SHARE website[1].

Lessons from the Covid-19 pandemic for radiological risk communication

[1] https://www.ssh-share.eu/news2/

The first webinar, attended by more than 550 participants, focused on risk communication and radiological risk perception to draw out relations to the Covid-19 communicative context. The following scholars and experts participated as panellists: Prof. Dr. Ortwin Renn, Prof. Dr. Britt-Marie Drottz, Mr. Patrick Meschenmoser, Mr. Azby Brown, Dr. Tanja Perko, Prof. Dr. Marie Claire Cantone, Ms. Ombretta Baggio and Ms. Joke Kenens.

The coronavirus crisis, it was noted, as well as nuclear accidents, are a good example of a systemic risk, highlighting the connectivity between health, economy, policy-making, public behavior and cultural life. Communication therefore is not only necessary in relation to health, but also must attend to the wider impacts, for example, on social cohesion, economic matters, environmental consequences, political trust and other issues. The panellists expressed the need to communicate a range of consequences for life, health, economy and social relations. Expertise from different disciplines may change over time and needs to be involved in communication efforts.

Prior research on risk perception or nuclear or radiological emergencies has shown that psychological dimensions are important in crisis situations. As in radiological emergencies, also in the Covid-19 pandemic, citizens need to think not only about their individual lives and those of loved ones but also about their locality and wider society. In the webinar we learned that the psychometric paradigm posits three dimensions that influence the prediction of human behavior in nuclear emergencies but possibly also in the Covid-19 pandemic: dread, novelty and catastrophic potential risk dimensions. Within each of these dimensions, there are specific factors that can aid better predictions of human behavior (e.g. voluntariness, ability for people to control their own situation, scientific uncertainty, irreversibility of the damage, availability of information, social justice, etc). According to the panellists, experiences from radiological emergencies show that people can be grouped according to risk perception patterns: a) those who underestimate the danger and break the rules; b) those who want to avoid any form of contact with others and c) those who like to fight and may stigmatise the others. We need to give these different types of people “agency”, so that they do not feel like victims to events outside of their control. Information should be available on options for action that people can undertake and thereby contribute to the collective good. In communication on crises, citizens should not be treated merely as audiences because they already hold useful information for effective decision-making. The relationships between message, recipient and subsequent action requires further study. Panellists pointed out that these patterns may be similar to patterns in the Covid-19 pandemic response.

The timescales of the impacts of a crisis vary between nuclear emergencies and pandemics like Covid-19. Previous nuclear emergencies have been eruptive crises whereas Covid-19, arguably, gave governments time to prepare, although preparedness has proven to be difficult. Panellists described how, after the Fukushima Daichii nuclear accident, citizens started to measure radiation levels in order to gain information directly and in many cases to contribute to scientific research. The need to have access to trusted information was key here and indeed helped people to make informed decisions. Some citizen initiatives, such as SAFECAST, did not only passively receive information from experts but performed their own measurements and added their own knowledge and expertise to the collective effort. They also demonstrated how easily handled equipment can be provided for all. We know that citizen science initiatives strive to bridge the gap between the language and practices of scientists and the language and interests of citizens and may also provide an alternative source of credible crowdsourced information. Such tools can be vital to make better decisions during a global emergency and can support better targeting of resources as well as enable governments and officials to be

held accountable. Although it is not yet clear to what extent crowdsourcing initiatives for the case of Covid-19 pandemic[2] will be effective, their potential benefits might be revealed in the future.

Decision-making in radiological emergencies and the Covid-19 pandemic involves uncertainties; this is a truism. What social science research has shown is that it is better to be open about uncertainties and include them in emergency communications in the radiological field, rather than attempt to ignore them. It is important to be clear about uncertainties, what is known and what is not known and create communication messages accordingly. However, this is rarely done in practice (Hoti et al., 2020).

Uncertainties identified systematically in radiological emergencies can be characterised in different ways, for example in relation to an emergency situation (Hoti et al., 2020):

- uncertainties related to knowledge (what is the origin of the initial information, how serious is the incident, what is the time of the beginning and end of the release, is information consistent);
- uncertainties related to judgment (balancing options; how is information understood by different stakeholders, how to decide on protective actions; are ethical and social considerations taken into account, what information is public and what is restricted);
- uncertainties related to decisions (how to prioritise options; how to manage trade off between short term action and long term consequences);
- uncertainties related to implementation (how best to operationalise decisions; how to coordinate cross-border aspects, how to communicate this, are all emergency response actors familiar with their roles, are they trained in the use of equipment, are available resources adequate);
- uncertainties related to evaluation and monitoring (observing what is done and with what kind of effects; will people follow instructions and recommendations given).

These uncertainties may be observed also during the Covid-19 pandemic.

From radiological emergencies, it is known that the more uncertain the information is, the more clarity in communication is needed. Communication should be open, transparent and timely. Disagreement between experts or between experts and governmental officials during emergencies are common and can lead to public distrust if information appears contradictory. For this reason, policy makers and politicians must make transparent how decisions are taken. In radiological emergencies, there is often a strong polarisation of opinions, particularly between those opposed and those in favour of nuclear energy. It is therefore important to mobilise scientific institutions, for instance academies of sciences, and other forms of institution, which have existing public trust.

Pandemics and radiological incidents are perfect situations for the spreading of rumour and misinformation. Rumours often result from a lack of, or unclear, communication. Panellists distinguished between two types of rumour, unintentional and intentional, and both forms can spread fast because of the combination of novelty value and use of social media. The internationalisation of crises also fosters the spread of information in ways that have not been seen in the past. Given the high degree of uncertainty in Covid-19 and in radiological risk, it becomes important to recognize the need to reach out to many different target groups using all possible communication channels, both traditional and digital (e.g. TV, social media channels). Rumour on some channels is difficult to manage due to the nature of the platform (e.g. person to person messaging) but these channels are part of everyday life and need to be factored into emergency planning, communications strategies, etc. Special attention should be paid to younger generations and plans made to disseminate information through their popular communication tools, which may not be the same tools as used by agencies, scientists and politicians. When responding to rumour and incorrect information, the response should be fast, from a well-respected authority or institution and use visuals as well as texts to explain. In places where authorities are not trusted, peer-to-peer information sharing may be a good strategy for

[2] See for example covid19map.safecast.org.

addressing information needs and for building societal trust on a horizontal level, rather than hierarchically. Often, the use of third-party communications specialists may be needed to increase credibility in the messaging provided by authorities or governments.

During Covid-19, the nations that demonstrated a unified voice across policymakers and the main science agencies, have reported that trust has been increased. Of course, a unified voice makes the job easier to send clear messages.

Balancing short-term action and longer-term outcomes

The second webinar which focused on balancing short-term action and longer term outcomes, was attended by more than 250 participants. The following scholars and experts participated as panellists: Dr. Wolfgang Weiss, Prof. Brian Wynne, Prof. Peter Thijssen, Prof. Deborah Oughton, Dr. Masaharu Tsubokura and MSc. Bojan Jean. The panellists pointed out that the similarities between non-radiological consequences of major nuclear accidents and non-viral consequences of the Covid-19 pandemic are many. For example,

- both are low probability and high-risk situations, resulting in a wide spectrum of serious risks to directly affected people and society at large;
- preparedness for crisis protection is paramount and if this is not done well, (more) people will suffer high consequences;
- key elements of preparedness which need to be considered include: mapping and adjusting existing protection resources (technical and personal); integration of the identified protection needs at all levels of health care including social support networks and the need to provide training to (medical) staff;
- decisions on protection need to be justified: they have to do more good than harm, have to save lives, and have to be convincing to enable people to act in response;
- following Chernobyl and Fukushima Daichii accidents, the scale of the impacts of non-radiological consequences on public health gained prominence over time. It took time to recognise that the consequences of the crises will remain for decades;
- the need to develop better communication concepts that can be used to help people better understand the trade offs between longer term consequences and immediate actions, remains, and is essential to (re)building trust.

Both radiation emergencies and the Covid-19 pandemic unfold over time and it is easy to generate public mistrust if scientific predictions turn out to unreliable and political statements are proven wrong. Yet prediction and certainty are clearly problematic concepts in both pandemic and radiological emergency situations. We heard during the webinar how scientific advice is inherently imbued with social assumptions, which are not always recognised and that are rarely tested. Therein lies a problem with respect to emergency responses, because incidents are often distributed and diverse and might create different effects with different populations.

In the aftermath of a radiological emergency as well as the Covid-19 pandemic, practitioners may recognise that they did not know what was happening. They did not necessarily know the scale, the focus, the cause, the dimensions of the problem, to be able to formulate the most effective response plan. Current assumptions that underpin existing response plans are largely understudied and panellists acknowledged that practitioners may be uninformed by social science and humanities expertise. Decades of research have shown how scientists can introduce social and political assumptions into their own scientific advice and communication (Turcanu et al., 2016). At the same time, policy-makers need to accept the plurality of experts, as there is no single qualified expert body of knowledge to handle a crisis, rather there are different relevant bodies of experts. In an emergency situation, policy-makers need to take responsibility for a particular synthesis of available advice and acknowledge that this will always be inadequate, given the limitations to knowledge.

Panellists demonstrated that the way in which statistics are shown is also an important factor in radiological emergencies and during the Covid-19 pandemic. They pointed out that they witnessed statistics used during both emergencies that lack clarity, omitted categories and referred to an array of numerical forms (absolute numbers, relative numbers, ratios, etc). Similarly, it may make more sense to focus on case fatality ratio rather than absolute number of deaths. But comparing countries on case fatality ratio can also be misleading, as it does not take into account the background of the countries, such as how many patients died in retirement homes or in hospitals, for instance. Not all countries report on mortality rates by age group and this raises questions about social solidarity between the young and the old, at a time when health and social effects are felt differentially in age terms.

Comparing Covid-19 with radiological emergencies, panellists pointed out that it is important to acknowledge that there are ethical challenges and this recognition may help to establish dialogue to address them. Scientific knowledge needs to inform policy but also needs to consider ethics, therefore an interdisciplinary approach is crucial. A pandemic tends to disproportionately affect vulnerable individuals (e.g. short-term contract workers, hardships for children, those living under circumstances of social and psychological stress). This is also seen in radiological emergencies: the impacts on elderly, farming and fishing industries, minority populations, for example. Any assessment of decisions and consequences needs to address a range of issues therefore and think of appropriate ways to mitigate the consequences.

In their Joint Statement "Covid-19: Ethical considerations from a global perspective", UNESCO's International Bioethics Committee and UNESCOS's World Commission on the Ethics of Scientific Knowledge and Technology, highlighted eleven key ethical issues to be considered before making decisions on Covid-19 (UNESCO, 2020). The statement covers vital ethical issues from a global perspective including human dignity and human rights, transparency, solidarity and cooperation, values, responsible research practices, etc. The joint effort underlined the importance of international collaboration and recognized that the World Health Organization (WHO, 2016) published a guidance document on ethical considerations in outbreaks.

We learned that following the Fukushima Daichii accident (2011), a wide range of health issues were reported in radioactively contaminated areas (Tsubokura, 2018), which included:

- radiation exposure;
- psychological and mental health related to the risk of evacuation (e.g. 25% of elderly people died within 90 days of evacuation);
- increased diseases with associations to lifestyle (e.g. diabetes, hypertension, certain cancers);
- stress associated with changes in the local and home environment e.g. as families separated, younger generations evacuated, populations decreased and aged, and social isolation was exacerbated.

A key challenge in health terms, both immediately and in the longer term, is prioritisation: which health issues are more important than others? People who evacuated following the Fukushima Daichii accident moved to temporary housing and many elderly people stopped their daily routines, including exercise, which resulted in physical and mental health deterioration and social isolation. These issues have also been identified in the Covid-19 situation. Mitigation for the problems generated by the immediate crisis measures need to be thought through and planned in advance and the longer-term effects of options and measures need to be disseminated clearly. One further aspect of the Fukushima Daichii accident was that there were changes to the supply and demand of medical services. Many hospitals closed due to logistical issues and supply problems. In Covid-19 too, panellists of the webinar concluded how fragile some health systems are when faced with a situation for which, ostensibly, most countries had planned.

Key challenges for managing a transition phase: lessons from the Chernobyl and Fukushima Daichii accidents

For the third webinar, SHARE teamed with NERIS, the European platform on preparedness for nuclear and radiological emergency response and recovery. This webinar was attended by over 350 participants. The panellists were the following scholars and experts: Dr. Thierry Schneider, Mr. Toshimitsu Homma, Prof. Elisabeth Cardis, Prof. Jacques Lochard, Dr. Catrinel Turcanu, Dr. Ciara McMahon and Mr. Edward Lazo.

Panellists pointed out that while Covid-19 and Fukushima Daichii accidents are very different types of disasters, there are potential commonalities in terms of management, countermeasures, communication, involvement of stakeholders, and consideration of the psychosocial and economic effects. The two research platforms believed that pandemic and radiological communities could benefit from sharing each other's expertise, successes and failures.

The ultimate goals of the transition phase of any emergency management activity are to restore social and economic activity in the affected areas to whatever extent possible, as well as to mitigate the impacts of the emergency and transition phase on the population, infrastructure and the environment. These goals present significant challenges not only to affected populations, but also to the organisations responsible for the emergency management and recovery activities in countries directly or indirectly affected by the event. After early countermeasures in a radiological emergency (e.g. evacuation, sheltering, iodine tablets distribution, food and water restriction), there is a need to put in place key protective actions for a longer-term period, given the high dispersion rate of radionuclides in the environment. The decisions required are multi-dimensional and complex. It is during the preparedness planning stage when it is necessary to involve and consult all relevant stakeholders in defining a framework for recovery management and preparing the transition phase for long-term recovery. It is in preparedness planning that emergency management can discuss what is technically feasible and what level of acceptability different measures may have for different stakeholders. In both nuclear accidents and the current pandemic, panellists have seen variability in the levels of preparedness and effectiveness of delivery of plans.

After the Chernobyl and Fukushima Daichii accidents, emphasis was initially on direct somatic effects of radiation (e.g. acute radiation sickness, cancer and non-cancer effects). It became clear that major health impacts are also indirect effects. Panellists stressed how relocation (loss of home, social relations, etc), uncertainties (e.g. due to conflicting information, distrust, stigma) and disruption to health services lead to stress, has negative social and economic impacts in affected populations and associated morbidity and mortality. The situation is comparable to the *direct* effects of SARS-CoV-2 (infection, pneumonia, tissue damage) and the *indirect* effects of the Covid-19 pandemic (social and economic impacts e.g. reduced incomes, hunger; uncertainties, conflicting information, distrust, stigma); and disruption of health services (mental health, increased morbidity and mortality, severity of other diseases not diagnosed or treated on time).

Panellists emphasised that stakeholder involvement needs to be considered during the transition phase of radiological emergency management as well as during the Covid-19 pandemic at two levels: first, implementation of protective actions by the authorities and second, implementation of protective actions by the affected people (i.e. self-help protection actions). The former inevitably raise negative consequences as decision-makers have to manage trade offs and potentially contradictory actions. The decision to decontaminate the environment, for instance, raises many ethical issues: protection of biodiversity, transfer of risk between public and workers, legacy of the waste resulting from decontamination, etc. There is no obvious order in the choice of ethical values to privilege and this is why stakeholder involvement in the decision-making process related to the choice of protective actions is crucial. It ensures that a variety of values are taken into account and that the affected people's concerns and expectations can be acknowledged, in order to ensure adhesion, maintain vigilance and prevent later controversies. A co-expertise process aims to share local knowledge between affected people and scientific experts, for the purpose of assessing and better understanding the radiological situation, to develop actions to allow people to protect themselves and also to

improve the local conditions. This process ought to be an integral part of the practical application of the optimization principle.

In the transition phase of any emergency, stakeholders will be actively interested in risks and in their own well-being. Decision-making will shift from the institutional to the individual level over time. Whilst countermeasures and protective measures will be initially implemented by governments and officials, at a later stage, individuals will need to make choices and manage everyday practices. Trust in institutions during radiological emergency management is crucial for all initiatives to be supported. This may be also important in the Covid-19 pandemic management.

Panellists emphasised that the objective of the transition phase decision-making process is preparing for a return to normal, but who decides what the new normal is? According to panellists, it is crucial that the 'normal' has to be shaped *with stakeholders,* using effective, open and flexible engagement processes. A 'command and control' system would break down at some point and therefore there needs to be a shift towards more collaboration and consultation and the number and range of stakeholders needs to be broader than is often the case. Experiences in radiological emergency management show that citizen led initiatives can also play a role and the transition phase actions should not only be those led by authorities. Authorities should recognize the importance of citizen led initiatives as a *complement* to their own.

Solidarity is one of the ethical values that has been noticeably different when comparing radiological accidents to the Covid-19 pandemic. Solidarity was at the forefront from the beginning of the pandemic because everybody was potentially affected whilst in a nuclear accident relatively few are affected. A challenge of the transition phase and recovery phase then, is precisely to develop solidarity between the groups who are unaffected and those who are affected.

Conclusions

Past major nuclear emergencies including Three Mile Island (USA, 1979), Chernobyl (USSR, now Ukraine, 1986), Tokai Mura (Japan, 2000) and Fukushima Daichii (Japan, 2011) contributed to important lessons learned related to emergency management. Prominent experts in radiological emergency management, scholars of different disciplines related to ionising radiation risks, representatives of international emergency response actors and of civil society, such as citizen science representatives, discussed which lessons radiological emergencies may offer to the Covid-19 pandemic management and vice versa. The discussions took place during the peak of the Covid-19 pandemic between March and May 2020. Although the Covid-19 virus was still spreading and the emergency was evolving in countries worldwide, the panellists in the webinars were able to demonstrate similarities in emergency management that may be potentially useful for an effective response. Radiological emergencies as well as the Covid-19 pandemic require complex emergency management, they confront society with numerous uncertainties and may impact the functioning of society at large as well as individuals, in particular. The discussions between the panellists, although often narrative, proved that there are experiences, research and knowledge from previous emergencies that can prove extremely useful and relevant for the current and future pandemic situations, although many lessons for effective emergency management are still to be learned and shared.

One of the main lessons learned is that non-radiological and non-epidemiological consequences of emergencies, e.g. psychological (mental health), societal and economic, should not be underestimated. Non-radiological consequences, for instance, psychological distress, alcoholism, unsafe sexual practice, insomnia state, misemployment, economic downturn or human relations problems may have a broader impact on society than radiological or epidemiological consequences.

Secondly, the decisions required in an emergency are multi-dimensional and complex. Any assessment of decisions and consequences needs to address a range of issues and think of appropriate ways to mitigate the consequences. As a result, the need to communicate different decisions as well as a range of consequences of the emergency related to health, economy, trust and social cohesion necessitates expertise from different disciplines (e.g. psychology, ethics, law, economy). Also, the importance of these disciplines may change over time. Therefore, multi and interdisciplinarity is imperative for communication efforts and for effective decision-making.

Thirdly, working closely with stakeholders, including the affected population and those most impacted by the pandemic or the radiological emergency, is important at all stages of an emergency. Involving stakeholders early in the decision-making process could contribute to improve effectiveness, meet democratic and ethical considerations, increase legitimacy and build mutual trust and understanding. Likewise, continuing engagement during and after the crisis, in the transition phase and the recovery phase is vital.

Finally, establishing trusted information is vital although challenging due to contextual factors, such as pressure to meet high information needs, high number of information sources, different opinions, changing social media landscape, rumours, etc. Showing a unified voice from policy-makers and main science agencies can increase trust in the authorities and compliance with protective actions. Additionally, citizen science initiatives strive to bridge the gap between the language and practices of scientists and the language and interests of citizens and may also provide an alternative source of credible crowdsourced information. Such tools can be vital to make better decisions during a global emergency and can support better targeting of resources as well as enable governments and officials to be held accountable.

One of the ethical values that has been noticeably different when comparing radiological accidents to the Covid-19 pandemic is solidarity. A challenge of the transition phase and recovery phase then, is precisely to develop solidarity between the groups who are unaffected and those who are affected.

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Appendix 1. Panellists in the SHARE webinars

All webinars can be accessed from the SHARE website at https://www.ssh-share.eu

Webinar 1: Lessons from the Covid-19 pandemic for radiological risk communication

Panellist	Organisation *
Prof. Dr. Ortwin Renn	Institute for Advanced Sustainability Studies (IASS) in Postdam, Germany
Prof. Dr. Britt-Marie Drottz Sjöberg	Norwegian University of Science and Technology, Norway
Mr. Patrick Meschenmoser	Mesh & Moser Situation Management, Austria
Mr. Azby Brown	SAFECAST, international volunteer non-profit organisation, Japan
Dr. Tanja Perko	SCK CEN and University of Antwerp, Belgium
Prof. Dr. Marie Claire Cantone	University of Milan, Italy
Ms. Ombretta Baggio	International Federation of Red Cross and Red Crescent Societies, Switzerland
Ms. Joke Kenens	SCK CEN and University of Leuven, Belgium

* The views expressed during the webinar are those of the panellists and do not necessarily reflect the policies or views of their organisations.

Webinar 2: Balancing short-term action and longer-term outcomes

Panellist	Organisation *
Dr. Wolfgang Weiss	Member of the German Commission on Radiological Protection
Prof. Brian Wynne	Lancaster University, United Kingdom
Prof. Peter Thijssen	University of Antwerp, Belgium
Prof. Deborah Oughton	Norwegian University of Life Sciences
Dr. Masaharu Tsubokura	Fukushima Medical University, Japan
MSc. Bojan Jean	Craftsmen and Entrepreneurs Fund, Slovenia

* The views expressed during the webinar are those of the panellists and do not necessarily reflect the policies or views of their organisations.

Webinar 3: Key challenges for managing a transition phase: lessons from Chernobyl and Fukushima Daichii accidents

Panellist	Organisation *
Dr. Thierry Schneider	CEPN (Nuclear Protection Evaluation Centre), France
Mr. Toshimitsu Homma	Japan Atomic Energy Agency, Japan
Prof. Elisabeth Cardis	ISS Global, Spain
Prof. Jacques Lochard	Nagasaki University, Japan
Dr. Catrinel Turcanu	SCK CEN, Belgium
Dr. Ciara McMahon	Environmental Protection Agency, Ireland
Mr. Edward Lazo	OECD Nuclear Energy Agency, France

* The views expressed during the webinar are those of the panellists and do not necessarily reflect the policies or views of their organisations.