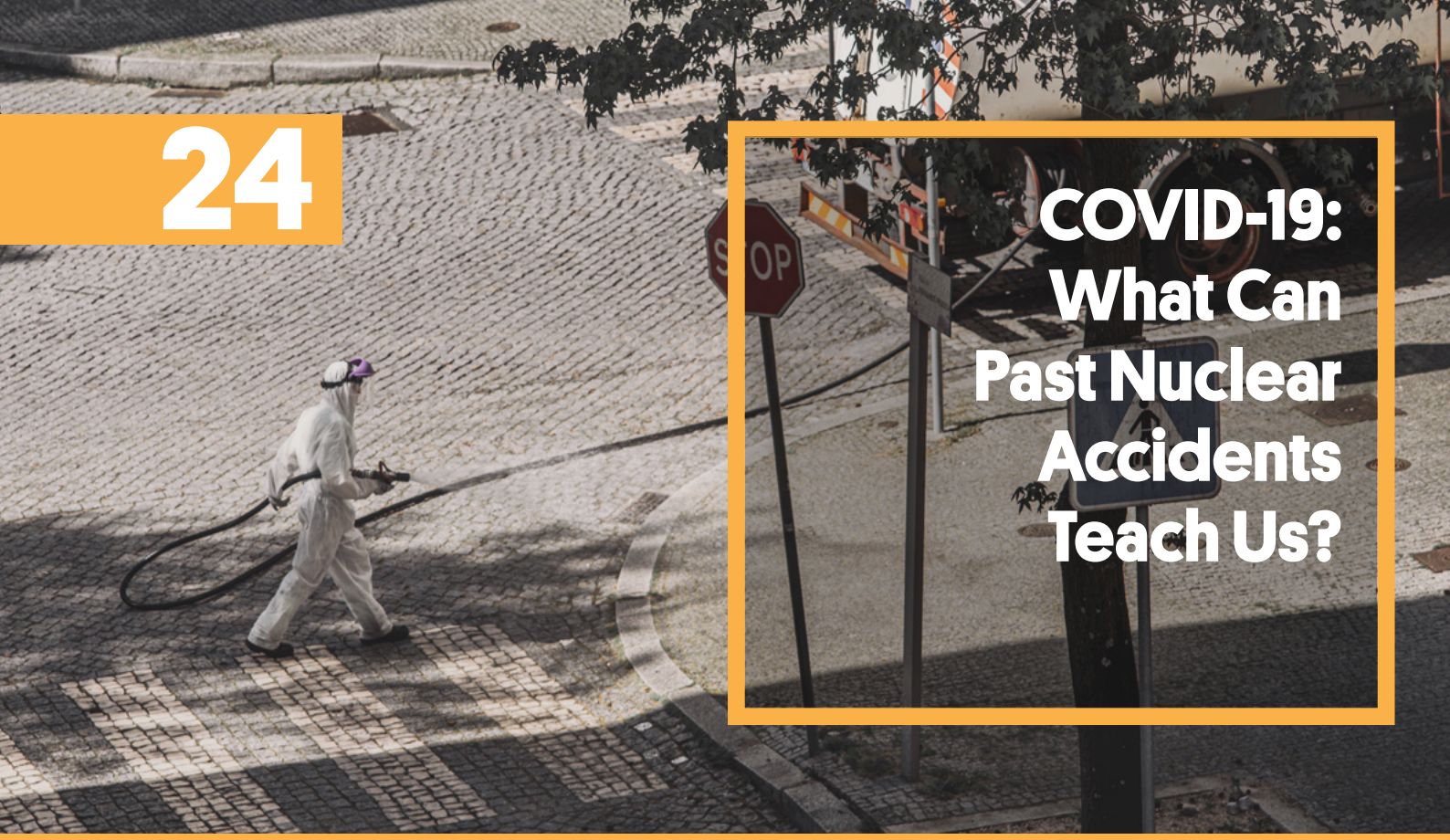

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COVID-19: What Can Past Nuclear Accidents Teach Us?

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[This document is a part of a series of discussion notes addressing fundamental questions about the COVID-19 crisis and response strategies. These documents are based on the best scientific information available and may be updated as new information comes to light.]

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In 2015, we launched SHAMISEN, a European project that brought together experts from across the world to examine **lessons learned** from the nuclear accidents of **Chernobyl and Fukushima**, and derived a series of **recommendations** to better prepare for future accidents and better survey the health of affected populations. Special emphasis was placed on adopting a **holistic approach** to accident preparedness, response and long-term surveillance and follow-up that would go beyond technical issues and consider **psychological, social and economic factors** related to the accident. The result of the two-year project was a set of 28 recommendations aimed at improving the overall well-being of affected populations in the case of a nuclear accident, responding to their needs and without generating unnecessary anxiety.

Five years later, we are in the midst of a pandemic caused by **a new coronavirus** (SARS-CoV-2) which spreads rapidly and has an estimated average lethality rate around 10-times higher that of the seasonal flu. In the absence of effective treatments or vaccines, countries across the world have been forced to implement a series of **mitigation measures** including international travel bans, school and business closures, and lockdowns in order to reduce transmission and avoid the overwhelming of health systems. Although these measures are not new, they are **unprecedented in terms of scale and duration**, and will undoubtedly have long-lasting psychological, social and economic consequences.

Adapting nuclear preparedness recommendations to COVID-19

Although these recommendations were originally written for radiation accidents, it is striking to see that most of them can be directly applied or readily adapted to

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the COVID-19 pandemic or in preparing for future epidemics (*Table 1*, in page 6, shows the SHAMISEN recommendations adapted to COVID-19).

Much like radiation, viruses cannot be seen, smelt or felt. Hence, the uncertainty of exposure is a shared feature in radiation accidents and viral disease epidemics, and may lead to similar psychosocial effects

1. General Recommendations For All Phases of the Epidemic

"The first general recommendation is particularly relevant. It refers to the fundamental ethical principle of doing more good than harm."

The first general recommendation (R1) of SHAMISEN can be translated directly to the SARS-CoV-2 situation and is particularly relevant. It refers to the fundamental ethical principle of **doing more good than harm**, which should be central to all decision-making processes during this and any other crisis that involves affected populations. As an example, **the strict lockdowns imposed in some countries**, where going to parks was discouraged or prohibited, may have had a deleterious effect on the mental and physical health of people living in urban areas, particularly children. Similarly, the social cost of closing schools in areas where viral transmission was relatively low may have been higher than the benefit in terms of infection control, particularly in children from less affluent families.

Along the lines of "doing more good than harm", R2 and R3 stress the need to encourage an infection control strategy that considers **the overall well-being of populations** and respects the **autonomy and dignity of affected populations**. Examples include contact tracing apps and other procedures, that need to be explicit about how and for how long personal data will be shared and stored.

Recommendations R4 and R5 apply to the **surveillance and monitoring of COVID-19 outbreaks**. Examples of how to improve existing monitoring systems for epidemiological surveillance have been proposed, including the **analysis of** wastewater to detect and quantify viral RNA, and performing **pooled tests** to detect infections in particular groups that need to be regularly monitored (such as healthcare workers, carers in elderly homes, or school classrooms). In terms of **contact tracing**, reverse contact tracing has been proposed to be a more effective strategy, given that a small proportion of cases (around 20%) seem to account for most (around 80%) of the transmission. The need to adapt the type of test to the situation (R5) is also becoming clear as the pandemic evolves. While **molecular (qPCR) tests** are necessary to confirm infection, especially in patients with symptoms, wide deployment of less sensitive but rapid **antigen tests** in settings such as schools, hospitals and work places can help control transmission by detecting pre- or pauci-symptomatic people with high viral loads and isolating them before they infect others.

Finally, **building an infectious disease prevention culture** among the general population (R6) is vital. We need to raise awareness among the public that this is not the first or last virus to jump from animals to humans, and that human activity (deforestation, biodiversity loss, etc) is raising the risk of future pandemics by zoonotic diseases.

We also need to raise awareness among policy makers, donors and other stakeholders on the **need to invest more in science** and encourage "One Health" approaches (surveillance of zoonotic viruses, development of diagnostic and vaccine platforms, broad-spectrum antiviral drugs, etc.).

The value of **non-pharmaceutical interventions** (hand hygiene, respiratory etiquette, use of face masks, physical distancing, etc.) for this and other respiratory infectious diseases needs to be taught early in school so they can be easily adopted when necessary. The **role of vaccines** in preventing infectious diseases should also be stressed •

2. Preparedness Is Key

"It is urgent to (re)build public trust in public health authorities, scientists, and multilateral organisms such as the WHO."

One of the main lessons drawn from Fukushima and Chernobyl is the **importance of planning "in times of peace"**. The COVID-19 pandemic has been a grim reminder that the world was ill-prepared to respond to an infectious disease pandemic, in spite of multiple warnings by the scientific community and public health experts over the last two decades. Once an infectious disease outbreak is detected, **a quick and coordinated response** is key to contain its spread. In fact, a recent study estimates that, given the initial transmission rate of SARS-CoV-2, governments had **just 20 days** from the first reported cases to implement stringent non-pharmaceutical interventions to reduce the Ro to below 1.1. Thus, **infection control protocols and criteria must be planned ahead of time** (R7), together with adequate resource allocation mechanisms. These protocols should span the early, containment phase (testing, contact tracing, quarantine, isolation) as well as the mitigation phase (expansion of hospital capacities and ICU beds, protocols and criteria for shelter at home orders, etc). The greater the participation of all actors involved in helping establish these, the higher the chance they will be successfully implemented (R10).

Another valuable lesson drawn from SHAMISEN is the need to **communicate in a timely and transparent manner** (R14) with the affected populations, and to **empower them** to make their own decisions (R21, R26). Again, the COVID-19 crisis has underlined the importance of providing clear, timely communication, and, importantly, on acknowledging the uncertainties linked to a new virus and a new disease. This can only be done if early response and communication protocols and channels are established in advance (R8), and the impact of these will largely depend on the degree of public trust in science and in the authorities. It is therefore urgent to **(re)build public trust in public health authorities**, scientists, and multilateral organisms such as the World Health Organization (WHO). Providing appropriate training and education material and resources to first line responders (nurses, healthcare workers, contact tracers, etc), is also key to enhance preparedness (R9).

Equally important is the need to **prepare frameworks and checklists** for testing and contact tracing (R11) and to enable the quick launching of clinical and epidemiological studies (R12). The identification of COVID-19 risk factors has been possible thanks to pre-established cohorts (UK's BioBank for example), and these cohorts will be crucial for understanding other key aspects such as duration of immunity and long-term sequelae of the disease. It is also important to prepare frameworks that allow the **quick start of clinical trials**, which are both ethical and rigorous, during an epidemic. Of the more than 2,000 planned studies to test COVID-19 treatments, most have delivered little or no useful information, with the exception of two large, adaptive trials (RECOVERY in the UK and SOLIDARITY, led by the WHO).

The uncertainties about overall consequences underline the importance of

gathering data not only on medical impacts, but also a range of societal and economic outcomes in order to improve evidence-based evaluation of different strategies. It is extremely important to also communicate these uncertainties, because making confident statements only to have to retract them a few weeks later doesn't contribute to the building of trust in the authorities concerned

3. Early (Containment) and Intermediate (Mitigation) Phases

"Government responses to the COVID-19 pandemic have varied considerably in terms of timing and scale of different containment and mitigation measures, underlining the need to establish evidence-based indicators and criteria."

Once an infectious disease outbreak is detected, there is a relatively small window of time to contain the spread of the disease, particularly in the absence of vaccines or effective treatments. Hence, the importance of **having established action protocols before the outbreak**. These protocols involve an early containment phase (based on testing, contact tracing, and isolation) and, if disease incidence is too high, a mitigation phase (based on non-pharmaceutical interventions such as social distancing, mobility bans, and partial or complete lockdowns) to avoid overwhelming of health systems.

Government responses to the COVID-19 pandemic have varied considerably in terms of **timing** and **scale** of these different containment and mitigation measures, underlining the **need to establish evidence-based indicators and criteria** that help optimise the timing and support for these different interventions (R13). Again, **providing timely, reliable and accurate information** (R14) to all actors involved (local authorities, health actors, general population) is a key ingredient for a successful response, and an antidote against the misinformation epidemic.

A central issue in the control of the COVID-19 epidemic has been **testing capacity**. Countries like Australia, South Korea and Uruguay have a positive rate of less than 1% – which means they perform hundreds, or even thousands of tests to find one case. According to WHO criteria, a positive rate of less than 5% is one indicator that the epidemic is under control. Therefore, governments should ensure that **adequate numbers and types of tests** (PCR tests, rapid tests) are available and used according to the epidemiological situation, and that support (explaining for example the difference between a serological test and a PCR test, or how to interpret the results) is provided to all those persons in the community who are tested (R15).

Finally, different types of **data** (clinical, demographic, socioeconomic) of those people tested must be **properly collected and stored** in order to facilitate clinical and epidemiological studies (R16 and R17) in a manner that respects the autonomy and dignity of affected people

4. Longer Term (Deconfinement, Recovery)

"Community engagement takes time and patience, but has been crucial in the control of previous epidemics such as HIV and Ebola, and is key for the collective response to COVID-19."

Given the socioeconomic and mental health impacts of some of the mitigation interventions (particularly school and business closures, and shelter at home orders), it is important to **establish common criteria for the lifting** of these interventions as soon as possible (R18). In fact, the **WHO** established six criteria for transitioning to and maintaining a low-level of transmission, including continued testing capacity (R19). These criteria were not met in some European countries that lifted restrictions too quickly and which are now experiencing a second wave of infections. Highly exposed essential workers, including healthcare workers and carers in elderly homes, should be prioritised in terms of regular testing (R20), but tests should also be made available to all those who need them (R21). This includes different types of tests, including self-administered rapid diagnostic tests- if and when available- as these may empower individuals to take decisions regarding their behaviour.

Long-term surveillance of infected individuals and epidemiological studies should be carefully designed and their long-term sustainability ensured (R22 and R23). This will maximise the information that can be obtained not only on the long-term medical impact of SARS-CoV-2 infection (particularly regarding "long COVID"), but also on a range of societal and economic impacts, in order to improve future public health policies.

One important lesson drawn by SHAMISEN was the need to **engage- and empower- local communities in the decision-making** process during the later phases of the response: use **local facilitators** (such as community leaders, nurses and teachers) who serve as a "bridge" between experts and the population (R24), consider the needs and preferences of people living in affected areas (R25), and foster their participation in infection control strategies (R26). Community engagement takes time and patience, but has been crucial in the control of previous epidemics such as HIV and Ebola, and is key for the **collective response** to COVID-19, from compliance with lockdown to individual behaviour when easing restrictions.

Finally, R27 (expand support of populations to **take into account economic and social upheavals**) could not be of more relevance to COVID-19. Although theoretically SARS-CoV-2 does not discriminate (i.e. everyone is at risk of getting infected), it turns out that those who have borne the greatest brunt of the disease are ethnic minorities and those living in poor socioeconomic conditions. For example, in the US Black Americans are 3 times more likely to get infected than whites, and the death rates among Black and Hispanic/Latino people in the US are much higher than for white people - among those aged 45-54, Black and Latino death rates are at least six times higher than for whites. Similar tendencies are observed across the world, and are in part explained by higher occupational exposure, less social distancing, and poor healthcare. Low socio-economic groups, including refugees, migrants and people working without legal contracts in high exposure occupations such as cleaning and construction, are particularly exposed to the coronavirus and to the psychological and socioeconomic impacts of the pandemic and mitigation measures. Governments must **design policies to support these vulnerable populations** (paid sick leave, minimal wages, access to quality healthcare services, etc.), both during lockdown and when restrictions are eased

5. Conclusions

"Two key general recommendations are particularly relevant: do more good than harm and encourage a strategy that targets the overall well-being of the population."

The key lessons drawn by SHAMISEN that can also be applied to this and future disease outbreaks are:

- **Preparedness** is key.
- Ensure **timely and reliable communication** between health authorities, experts and affected populations during all phases of the crisis.
- Need to **engage citizens in the response**, particularly in the later phases.

Many of the recommendations that were developed for improving health and well-being of populations affected by nuclear accidents can be directly implemented or adapted to the current COVID-19 crisis (or future disease outbreaks).

Two key general recommendations are particularly relevant to bear in mind when managing this or any other crisis involving affected populations:

- Do **more good than harm**.
- Encourage a **strategy that targets the overall well-being of the population**.

Table 1. From Radiation Accidents to Infectious Disease Pandemics: SHAMISEN Recommendations Adapted for COVID-19.

General
R1. The fundamental ethical principle of doing more good than harm should be central to pandemic management
R2. Encourage an infection control strategy that targets the overall well-being of populations
R3. Ensure that infection control respects the autonomy and dignity of affected populations (avoid stigma, discrimination)
R4. Review, and if needed improve, existing monitoring systems for epidemiological surveillance
R5. Adapt testing and monitoring to the epidemiological situation
R6. Build an infectious disease prevention culture

Infection control measures
Testing and surveillance
Communication and training
Health and epidemiological studies

Preparedness	Early (containment) and intermediate (mitigation) phases	Longer term
R7. Prepare containment and mitigation protocols and criteria	**R13.** Optimize timing and support for implementing infection control measures based on scientific evidence	**R18.** Have criteria and plans for lifting of infection control measures as soon as possible
R8. Establish early response and communication protocols and channels **R9.** Prepare and facilitate training and education material and resources **R10.** Foster participation of stakeholders and communities in pandemic management and infection control	**R14.** Ensure prompt sharing of accurate and reliable information	**R24.** Build networks of experts – local facilitators – population **R25.** Consider the preferences of people living in areas where infection control measures are implemented **R26.** Foster long-term participation of communities
R11. Prepare frameworks and checklists focused on testing and contact tracing	**R15.** Provide support to populations who undergo testing **R16.** Collect and store all testing-related data	**R19.** Maintain testing and tracing capacities **R20.** Regular testing for those most exposed or in contact with the most vulnerable **R21.** Continue providing testing support to all populations
R12. Prepare frameworks and checklists for clinical and epidemiological protocols of stakeholders and communities in pandemic management and infection control	**R17.** Create a common roster of affected individuals	**R22.** Clarify objectives and expected results of epidemiological studies and ensure their long-term sustainability **R23.** Ensure sustainability of follow-up studies of infected individuals **R27.** Expand support of populations to take into account economic and social upheavals

Infection control measures
Testing and surveillance
Communication and training
Health and epidemiological studies

TO LEARN MORE

- What developing countries can teach rich countries about how to respond to a pandemic. *The Conversation*. October 2020.
- A vision for actionable science in a pandemic. *Nature Communications*. September 2020.
- Developing infectious disease surveillance systems. *Nature Communications*. September 2020.
- Improving Pandemic Preparedness: Lessons From COVID-19. Council on Foreign Relations. October 2020.

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