

# A nuclear shadow from Hiroshima and Nagasaki to Fukushima

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70 years ago this week, in the quiet early morning of Aug 6, 1945, the world changed irreversibly when the first nuclear weapon in warfare was used by the USA against Japan. The target of Hiroshima had been spared previous bombing, so that the destructive force of the 15 kiloton uranium bomb could be assessed. The result, repeated 3 days later against Nagasaki with a larger plutonium device, was near-total devastation. The explosion melted metal and incinerated people. Exposure to ionising radiation led to further deaths and damage to health that can be measured today, as Kenji Kamiya and colleagues report in the first paper of a Series in *The Lancet* today.

In the immediate aftermath of the bomb, doctors such as Michihiko Hachiya (author of *Hiroshima Diary*), struggled to make sense of the symptoms and signs in survivors, but noted the poor prognosis associated with petechiae. Only when his hospital received a microscope to replace the one destroyed in the blast, did the causes become clearer. In *The Lancet's* Series, a new lens is applied to events from Hiroshima and Nagasaki to Fukushima, for a better understanding of the health challenges faced by populations exposed to radiation from man-made disasters. The Series provides an opportunity to consider civil protection and health service provision before the next nuclear catastrophe occurs. As a result, evacuation can be better planned, messages about risk communicated more clearly, treatment targeted more efficiently, and priorities for data collection established to improve understanding and management. The three Series papers are led by authors in Japan, coordinated by Koichi Tanigawa of Fukushima Medical University and Rethy Chhem, formerly of the International Atomic Energy Agency.

The Hiroshima bomb provides a convenient opportunity for reflection, but even in the absence of that anniversary, the danger of nuclear attack remains present and timely. The world bristles with more than 15 000 nuclear warheads, believed to be concentrated in nine countries (excluding states that host weapons from other governments). Worryingly, three countries that admit to nuclear weapons are not parties to the nuclear non-proliferation treaty: India, Pakistan, and North Korea. Little wonder that for two generations, the doomsday clock has hovered near midnight. Yet, health professionals, such as International Physicians for Prevention

of Nuclear War, have helped to turn back the doomsday clock in the past. The medical community should consider their example—and the contents of this Series—to inform contemporary debate on nuclear weapons, especially as Iran's nuclear programme hangs in the balance. The negotiations between the USA and Iran that concluded on July 14, although unpalatable to some, are of potentially immense importance to reduce the risk of war in the Middle East, and to improve the health of people in Iran by the reduction in sanctions.

Nuclear technology also provides benefits: notably in scientific research, medical diagnosis, and treatment. Electricity from the world's 437 nuclear power plants supports development. Yet the understanding of nuclear risk by most clinicians—and especially by the general public—has not advanced as deeply or as widely as has the uptake of nuclear technology. The knowledge gap is fortuitous in that there have not been more major nuclear disasters to learn from, but it is also dangerous, because answers to many questions are unknown and cannot be extrapolated from the experiences of Hiroshima, Three Mile Island, or Chernobyl. Nonetheless, health professionals will be expected to provide guidance at the next nuclear incident and to care for the many tens of thousands of people in evacuation zones. Therefore, common features of such events, described by Arifumi Hasegawa and co-authors in the second Series paper, and recommendations for responses, discussed by Akira Ohtsuru and colleagues in the third Series paper, make valuable reading.

Japan's unenviable experience of man-made nuclear disasters can inform scientific and ethical approaches to nuclear technology elsewhere. For nuclear power, two (among many) lessons from Fukushima are that seemingly fail-safe mechanisms can fail, and that when they do, health professionals will be expected to provide timely, accurate, and unambiguous advice, despite scarce evidence. For nuclear weapons, survivors from Hiroshima and Nagasaki remind the world of the barbaric consequences that result from using such devices against civilians (see World Report). As they grow older and their radiogenic malignancies progress, their concerns need to be embraced by new generations and extended to censure not only governments, but also any terrorist organisation that contemplates radioactive weapons.



Bulletin of the Atomic Scientists

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World Report

## Hiroshima survivors remember

[Justin McCurry](#)

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Ahead of the 70th anniversary of the atomic bomb attack on Hiroshima, three survivors recount their memories of that day and their health experiences since. Justin McCurry reports.

Sunao Tsuboi's facial scars are proof enough of his status as a witness to the horrors of the first nuclear attack in history. But, as if to clear up any lingering doubt, he begins speaking to *The Lancet* by summarising his medical history: 40 days' lying unconscious, a year of immobility, numerous stays in hospital, and three close encounters with death.

At 90 years of age, Tsuboi is preparing to mark 70 years to the day that the USA dropped Little Boy, a 15-kiloton nuclear bomb, on his hometown of Hiroshima on the morning of Aug 6, 1945. Between 60 000 and 80 000 people were killed instantly; in the months that followed the death toll rose to 140 000.

As of August, 2014, the number of people recognised as having died from the effects of the two atomic bombings stood at more than 450 000: 292 325 in Hiroshima and 165 409 in Nagasaki, which was bombed 3 days later.

Tsuboi, then a 20-year-old university student, was walking through central Hiroshima about 1 km from the hypocentre when the US B-29 bomber the Enola Gay released its payload. He remembers hearing a “loud bang”, then being blown into the air and landing 10 metres away. He regained consciousness to find that most of his body had been burned, and the sleeves of his shirt and the legs of his

trousers ripped off by the force of the blast. “My arms were very badly burned and there seemed to be something dripping from my fingertips”, Tsuboi, co-chair of Nihon Hidankyo, a nationwide organisation of atomic and hydrogen bomb survivors, told *The Lancet* in a recent interview in Hiroshima. “My back was incredibly painful, but I had no idea about what had just happened. I assumed I had been close to a very large conventional bomb. Of course, I had no idea that it was a nuclear bomb and that I'd been exposed to radiation.”

As he struggled to escape the fires blanketing most of the city, he witnessed scenes that, just for a moment, distracted him from the pain coursing through his own body. “There was so much smoke in the air that you could barely see 100 metres ahead, but what I did see convinced me that I had entered a living hell on earth”, he said.

“There were people crying out for help, calling after members of their family. I saw a schoolgirl with her eye hanging out of its socket. People looked like ghosts, bleeding and trying to walk before collapsing. Some had lost limbs.”

“There were charred bodies everywhere, including in the river, into which people had jumped to escape the flames and quench their thirst. I looked down and saw a man clutching a gaping hole in his stomach, trying to stop his organs from spilling out. The smell of burning flesh was overpowering.”

In one of only a few surviving photographs taken in Hiroshima on the day of the attack, Tsuboi can be seen sitting among a group of exhausted survivors outside a gutted building on Miyuki Bridge, 2 km from the hypocentre. “There was no treatment available, and no food or water”, he said. “People looked at me and said they were amazed I was still alive.”

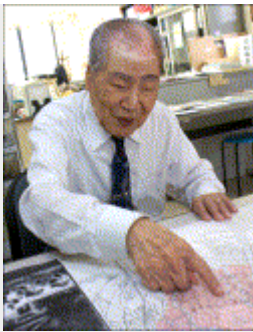
Tsuboi was eventually picked up by an army truck and taken to a hospital, where he remained unconscious for more than a month. By the time he regained consciousness, on Sept 25, Japan had surrendered and was under the control of the US-led allied occupation. “I had no idea that the war ended”, he said. “I struggled to take it all in.”

Since then, Tsuboi has been hospitalised 11 times. On three occasions—10, 18, and 23 years after the bombing—doctors told him to summon his relatives to say a final goodbye. “They came to the hospital shocked to find that I was still alive”, he said. Then he laughed: “In fact, people are still saying that to me.”

After Japan announced its surrender on Aug 15, Tsuboi returned to Hiroshima University and went on to become a maths teacher and high school principal. But he has been defined by his mission to pass on the message of the *hibakusha* (atomic-bomb survivors)—one that he fears will be lost once he and his ageing contemporaries are no longer around.

His anti-nuclear campaign has taken him to several countries including the USA, China, India, and Pakistan. The original photograph of him taken just after the Hiroshima attack hangs in the UN building in New York.

He is sustained by a daily cocktail of drugs to treat a list of ailments he says are directly connected to his exposure to radiation 70 years ago, including chronic aplastic anaemia, angina, cancer of the large intestine, and prostate cancer. Every fortnight he has an intravenous drip—an “energy boost”—and has had to take blood-forming medicine and nitroglycerine throughout his adult life.



Sunao Tsuboi indicates where he was in Hiroshima when the bomb fell in August, 1945

Justin McCurry

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Hiroko Hatakeyama looks at a family photo taken before the nuclear attack on Hiroshima

Justin McCurry

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The *hibakusha*'s medical histories have given scientists a rare insight into how radiation exposure affects the human body. According to the joint Japan–US Government-funded Radiation Effects Research Foundation, the proportion of cancer deaths attributable to radiation exposure is considerably higher in *hibakusha* who were exposed closer to the hypocentres. “Overall, nearly half of leukaemia deaths and about 10% of solid cancers are attributable to radiation exposure”, the Foundation says, based on its Life Span Study of 120 000 Hiroshima and Nagasaki residents, including 27 000 who were not exposed to radiation. “If one assumes that Life Span Study survivors represent about half of all survivors in the two cities, the total number of cancers attributable to radiation exposure through 2000 may be about 1900 cases.” Although the risk of developing leukaemia has virtually disappeared over time, “excess risk for cancers other than leukaemia (solid cancers) has stayed constant and seems likely to persist throughout the lifetime of the survivors”, the Foundation added.

Tsuboi, who has two daughters, a son, and seven grandchildren, was first diagnosed with cancer when he was 75 years, and again at the age of 81. He is convinced that his proximity to radioactive fallout left him susceptible to the disease.

But like other survivors, Tsuboi faces another threat to his ability to pass on his experiences to the wider world: the passage of time. Advanced age and illness is expected to cause a spike in the mortality rate among witnesses to the Hiroshima and Nagasaki attacks in the coming decade. The average age of the 183 000 registered survivors of both attacks rose just above 80 years for the first time this year, according to Japan's health ministry.

“In 10 years, I'd be surprised if there are many of us left”, said Hiroshi Shimizu, who was at home with his mother, when the Hiroshima bomb exploded about 1.5 km away, 580 metres above ground.

Although the survivors' spoken and written testimonies are now matters of historical record, Shimizu and other *hibakusha* are trying to ensure that their experiences don't die with them, at a time when the world faces new nuclear risks. North Korea has made progress towards developing a nuclear arsenal, and earlier this year the Russian leader, Vladimir Putin, indicated he had been prepared to deploy nuclear weapons during the Crimean crisis.

“If the *hibakusha* continue to speak out against nuclear weapons, then other people will follow suit”, said Shimizu, who was 3 years old when Hiroshima was attacked and now serves as secretary general of the Hiroshima prefectural branch of Hidankyo. “That is why we have to continue our campaign for as long as we are physically able.” For a decade after the war he battled debilitating bouts of diarrhoea—the result, he says, of radiation damage to his intestines. “I also had terrible nosebleeds and would wake to find my futon covered in blood.”

He also suffered from what atomic bomb survivors have come to call *buraburabyo*—a condition that leaves them overwhelmed by fatigue. “Your head is telling you to get on with things, but your body won't let you”, he said. “But doctors still don't know exactly what causes it.”

Shimizu's ailments had subsided by the time he was 12 years old, but his kidneys have a third of their normal function and he has angina. Of the 11 illnesses Japan's health and welfare ministry recognises as caused by the atomic bomb, Shimizu says he has symptoms of six of them.

Hiroko Hatakeyama, who was 6 years old in August, 1945, says dwindling attendances at her primary school class reunions are proof of the devastation the bomb inflicted on the health of those who survived. Of the seven pupils from her primary school class with whom she is still in contact, four have cancer.

The 76-year-old was forced to curtail her anti-nuclear activism after having a stroke in 2006. Her failing health is typical of many ageing *hibakusha*; earlier this year one of the most active branches of Hidankyo announced it would disband after its members, most of whom are in their 80s and 90s, conceded they were too old to continue.

“I won't be here in 10 or 15 years' time, so the question we're all asking is how to continue sending our message”, Hatakeyama said. “I barely have the energy to campaign these days, and I'm no longer scared of dying. But at the same time I realise that it's our duty as survivors to carry on for as long as possible, to honour the memory of those who are no longer with us.”



Hiroshima on Aug 6, 1945, after the bomb was dropped

Corbis

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