

原子力災害と向き合って

Countermeasure against nuclear disasters

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要旨：人類史上最悪の原子爆弾が、広島、長崎にそれぞれ投下されてから73年が経過し、生存している原爆被災者の高齢化とその減少に伴い、当時の貴重な経験や教訓が風化の危機に晒されています。そこで、本年は、本学会が長崎で開催されることから、原爆被災直後の救護活動に携わった代表的な医師の一人である永井隆博士生誕110周年を記念し、永井隆博士の人間性に学ぶと同時に、博士を敬慕し続けナイチンゲール賞を受賞された久松シノノ氏の「凛として看護」を学び直す貴重な機会であると言えます。すなわち、原爆被災からの再起と復興を糧に、長崎の地に学んだ私たちがいかにその経験と教訓を生かし、現代リスク社会の中で新たな役割を果たす使命と責務があることを共に考えたいと思います。

その上で、東日本大震災、そして東京電力(株)福島第一原子力発電所事故から7年半を経過しようとしています。今なお避難を余儀なくされている方々や、震災関連での多くの障壁のために、生活の困難や不便さを甘受されている被災者に心からお見舞い申し上げます。震災、そして原発事故後の混乱と混乱の中で、放射線影響研究や被ばく医療を専門とする医療人が、いかなる信念と行動規範に基づき、日本の禍機とも言える困難の中で東奔西走し、危機的状況を乗り越えたのかその活動精神の一端を紹介します。

本依頼原稿の本文は、日本語ではなく英語で紹介しますが、理由は同じテーマです。すでに本年6月の原子爆弾後障害研究会で先に書かせていただき、重複を避けると同時に、放射線看護領域でもグローバル化対応に少なからずお役に立てるからだと思うからです。ご理解頂ければ幸いです。

It has now been 73 years since the disaster of atomic bombings in Hiroshima and Nagasaki, and the situation surrounding the current modern risk society has changed dramatically: we are facing the decay and also difficult succession of the valuable experience and lessons learned from the atomic bomb survivors because of their aging and the decrease of the alive victims.

Radiation's effects on the human body have always reminded us of the negative impact of the atomic bombings in Hiroshima and Nagasaki and the competition in nuclear weapon development. What we should do now is to keep thinking about and practicing self-discipline to rebuild and maintain trust among people in various situations, even after the nuclear disasters.

Now, I would like to focus on the spirit and ideas of Dr. Takashi Nagai, which represent fully decent humanity rooted in Catholic beliefs, in commemoration of his 110th anniversary of his birth. As we approach the milestone of the doctor's 110th anniversary, we have inherited the feelings of our predecessors who were deprived their lives

by the atomic bombing. We will remember their will, recommit to our mission and role of undauntedly advancing studies on the after effects of radiation exposure, and explore proper reactions to be taken in the event of nuclear power plant accidents based on the lessons left by Dr. Nagai. Your understanding would be highly appreciated if you challenge to read this English version, preparing for globalization.

Dr. Nagai's philosophy of life

The stark reality is that every person dies. Whether we believe in a life after death or not, each one of us has his or her own view of life in the present. Even a person who has no religion has to have something to believe in and take into consideration, in order to live. Nursing as well as Medicine is that work which helps people to recover from illnesses; it demands not only diagnoses and evidence-based approach but also care and cures from both mental and physical aspects. The field needs medical personnel, researchers and, nurses and health professionals who have an unwavering view of life and an inseparable relationship with society.

First, let us consider the beliefs of Dr. Nagai, who saw the atomic bombing as the providence of Heaven and who was greatly influenced by his experience of being poised between life and death as a military surgeon during the Second Sino-Japanese War and his encounter with his future wife, Midori, a Catholic since her birth, in Urakami, Nagasaki. Born originally into a Shintoist family in Izumo, in the Shimane Prefecture, he was raised with the idea to "Revere Heaven, Love People" and was greatly influenced by his father, who helped him to gain perspective on the existence of souls when faced with his mother's death. Among the four elements of human life, which are birth, illness, aging, and death, the greatest risk in the present world is obviously the risk to life, or, in other words, death. This fact applies even to the developed society of the 21st century, despite our remarkable advances in life science and technology.

Dr. Nagai gained and demonstrated this idea of human love as he was transferred from place to place in China during the 1937 Shanghai Incident (the Sino-Japanese War). He wrote poems and made picture postcards at the very moments when he was poised between life and death. Here are some of his compositions ("Tanka"), introduced by the late Dr. Kinichiro Hamazato, a radiologist, which depict lively scenes when he came across the enemy in China.

- As we land on the shore, the morning mist flows, immediately before enemy's shooting begins.
- Around a cactus basket on the corner, I gasp in surprise, running into an enemy face to face.
- I jumped over the basket to catch the wrist of the enemy soldier; it was warm and sweaty.
- The enemy who ran away left behind a pot of millet. I wash and then prepare supper with it.

Surprisingly, Dr. Nagai volunteered to provide medical care to local residents while being transferred among inland villages across China. His venerable and fair behavior as a doctor who served everyone under the extreme circumstances of the war, regardless of nationality, race, social status, or whether friend or foe, is, indeed, touching.

- While I am diagnosing this man, forget about his nationality
- At a stone house hides a person who fails to escape, in the subdued voice telling his suffering of asthma.

Of course, it is never easy to equate the historical person who lived in a different environment and with a different social background with people in the present. One universal view of the environment and health, however, holds that there are ever-present and life-threatening risks around us, such as negative health effects and anxiety brought by radiation exposure. We are always surrounded by invisible health and life risks. This implies many commonalities between his time and our own.

It is presumed, concerning his illness, that Dr. Nagai operated an X-ray irradiation system without X-ray films when the war was close to end and everything was in a state of shortage. Under those circumstances, he had no option but to perform a diagnostic on chest X-rays directly using fluoroscopy. This repeated exposure for himself to the radiation from these chest x-rays caused him to eventually develop chronic myeloid leukemia. After experiencing this, coupled with his close exposure to the radiation from the atomic bombing, he had a

narrow escape from death and accepted his fate: not only his past, but also what would happen to him in the future. Even after becoming ill as the war ended, he seemed to enjoy a robust spiritual life at a very small home called “Nyoko-do” Hall at Urakami in Nagasaki. There, he continued writing from his sick bed, which is said to be a miracle. Speaking not only as a medical practitioner, but also as a human being, I have deep respect for his way of life; he literally encountered once-in-a-lifetime circumstances that led to a daily self-awareness of death, and he demonstrated an excellent model for terminal care in working with the natural courses of disease. Moreover, he was a paragon for developing humans’ capabilities, which remain applicable to today as we pursue the best ways to maintain a sound mind and resilient way of life in the midst of hardship.

The greatest crisis among the many challenges and difficulties he met in his life was undoubtedly the atomic bombing. Witnessing the immeasurable casualties in the area utterly devastated by the bombs led him to front-line relief activities immediately following the bombings. We should learn from his steadfast dedication to providing a proper response to nuclear disasters.

***Atomic Bomb Rescue and Relief Report* by Dr. Takashi Nagai**

August 9, 1945, 11:02 A.M. The second atomic bomb, following the first in Hiroshima, was dropped in the Urakami area of Nagasaki City, which turned into a very hell of agony and despair. Valuable reports about Dr. Nagai’s relief support activities performed immediately after the bombing have been archived.¹⁾ Among them is his *Atomic Bomb Rescue and Relief Report*, which is full of lessons learned from the atomic bombs, the theme of this article. It is an invaluable reference for medical personnel (Figure 1). The report, which should have been submitted to Kohei Koyano, the President of Nagasaki Medical College (now the School of Medicine at Nagasaki University) after its completion in October 1945, had been missing for 25 years and was discovered with great repercussions. Aside from its mysterious history, the report is incredibly logical, despite having been compiled without reference materials or supporting literature, nor being polished or revised; this

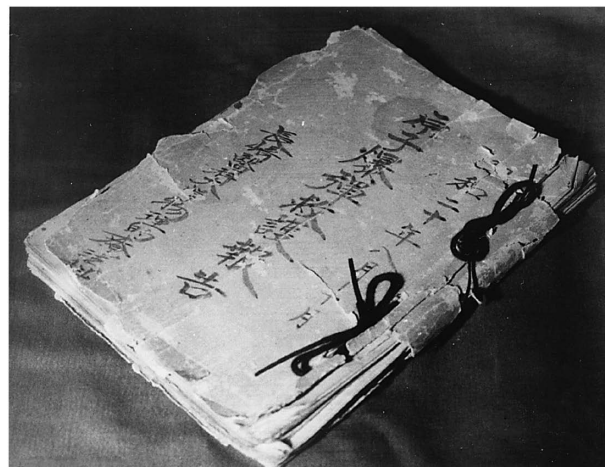


Figure 1. *Atomic Bomb Rescue and Relief Report* (courtesy of the Atomic Bomb Disease Institute Nagasaki University)

demonstrates the value of passing it down for posterity. The records it includes are full of ideas and observations rooted in his profound knowledge.

The contents and outline are as follows.

- Chapter 1 Thoughts on atomic bombs
 - Section 1 The explosion of atoms
 - Section 2 Bombings
 - Section 3 Impact of the atomic bombs
- Chapter 2 Overview of radiation injuries
 - Latent period—tissue sensitivity—tissue damage—systemic disorders
- Chapter 3 The Japanese Army’s actions
 - Section 1 The day of the explosions
 - Section 2 Days 2 and 3
 - Section 3 The Mitsuyama relief squad
- Chapter 4 Symptoms of patients after the atomic bombing
 - Section 1 Categorization of symptoms
 - Section 2 Details of symptoms
- Chapter 5 Statistics of patients after the atomic bombing
 - Section 1 Overall statistics
 - Section 2 Injuries
 - Section 3 Deaths
- Chapter 6 Medical therapies
 - Section 1 Milieu therapies
 - Section 2 Spa therapies

Section 3	Stimulation therapies via autologous blood transfusions
Section 4	General symptomatic therapies
Chapter 7	Prediction of the future and its measures
Section 1	Residential issues near the epicenter
Section 2	Damage to the human body (delayed diseases-late diseases)
Section 3	Agricultural products
Chapter 8	Observations
Section 1	Atomic bombs
Section 2	Personal injuries
Section 3	Treatments
Chapter 9	Reflections
Section 1	Advanced preparations
Section 2	Post-bombing efforts
Chapter 10	Conclusion

The medical treatment record presented in the former part of this report simply describes how, after the war ended following the Nagasaki bombing, Dr. Nagai examined 125 people who had been exposed to close-range radiation for a total of 1829 days. Among this group there was a high death rate, 23%. By observing the patients' clinical symptoms, he categorized their injuries as prompt, early, delayed, or late, based on their expression periods, and described them as follows: external injuries, burns, combined injuries, early digestive problems, early blood disorders, delayed blood disorders, and indirect disorders. By examining the available therapies, he also presented the effects of stimulation therapy via autologous blood transfusion and spa therapies, which were difficult to evaluate clinically now due to their short-term possibility for observation.

His report unveils the efforts and regrets of his predecessors who had strived to provide the best medical care under such extreme circumstances and with limited capabilities, often which only allowed them to perform simple blood tests, in addition to their physical examinations, to form the basis of medical treatment. Still, he noted, people engaged in all relief activities tried their best at the time. He commented that he respected milieu therapy and advised patients to rest at home; this clearly demonstrates the quintessential aspect of medicine: looking into a patient's mind using a

doctor's eye.

Nagai's report remains outstanding, despite the passage of time, because it discusses the future of radiation exposure influences near the epicenters of the bombings and how they relate to the human body while also aiming to observe and reflect on the atomic bombs themselves, based on his knowledge and personal experience. His ultimate intention appears in the comment, "Finally, I can serenely reflect on my behaviors and clarify the responsibility of Japan's defeat in the war".

In Chapter 9, he points out his responsibility for not taking measures to prevent the atomic bomb attack, despite his specialized expertise of radiation medicine, and his deep regret regarding his failures as a doctor aiming to provide guidance to his patients. He also blames himself for failing to measure residual radioactivity after the disaster, which resulted in a lack of evacuation measures that could have led bombing survivors to safer places. Considering that the situation at the time made it extremely difficult to rescue people who had been in close proximity to the epicenters' blasts and seriously burnt or injured what made Dr. Nagai, a man of outstanding knowledge and humanity, regret so deeply the response to residents' evacuation when they were exposed to radiation: that they should have been evacuated immediately from the devastated area? This can be explained as nothing apart from his far-sightedness, which allowed him to predict the occurrence of late-onset consequences of radiation injuries. However, many victims died from the bombs' explosions and the injuries they suffered right away. It was to be expected that there would be acute radiation injuries caused by exposure to such a large amount of radiation. His words may have come from his deep sadness and regret for the helpless people who died.

In Chapter 10's Conclusion, Dr. Nagai reveals his honest feelings. He makes comments that are seemingly the only complaints in the entire work, warning the Japanese people about their disdain for and illiteracy when it comes science by referring to the atomic bombing saying, "It caused an enormous terror, like a bolt from the blue, in the brain of Japanese people who are scientifically in sleep". Furthermore, he

shows his amazement in the results of the research and development capabilities of technology that the U.S. demonstrated. This exceeded his hatred of the misery inflicted by the atomic bombs, and he encouraged the Japanese people to work to understand pure science and to develop not only an interest in radiation and nuclear physics, but also a yearning for the peaceful use of atomic energy.

Response to the Fukushima nuclear power station accident and the spirit of Dr. Nagai

Dr. Nagai presented a lecture on acute radiation syndrome at the Plenary Session of the Acta Medica Nagasakiensia in November 1946 in Nagasaki; he had been invited to do so as one of the doctors who had been subject to radiation exposure after the bombing (Figure 2). Although the official record of the presentation has been regrettably lost, because the journal for that year was unpublished, his speech reportedly presented the situation of the damage at that time in detail. This information was passed down via later studies and reports on radiation consequences and is represented by the *Document of the Nagasaki Atomic Bombing*, by Dr. Kodo Yasuyama, which took 40 years to be published after its completion in 1951 (it was reprinted in 2007),²⁾ and *The Concentric Circle of Death*, by Dr. Tatsuichiro Akizuki.³⁾ It was not only these researchers, but also Prof. Raisuke Shirabe, a doctor who specialized in Nagasaki atomic bomb-related diseases, and other people concerned who undertook the painstaking efforts and showed undaunted perseverance to restore and reconstruct the demolished Nagasaki Medical University at the very site of the atomic bombing.⁴⁾ I would like to call the feeling and spirit of our forerunners, as described above, the “Nagai spirit”. There are more works to which we should also turn our eyes: *Nursing Solemnly*, by Shisono Hisamatsu,⁵⁾ who worked as a young head nurse in the then-Department of Physiotherapy (present-day Radiology) and who later led the Nyoko-no-kai Association along with the late Kinichiro Hamasato as President, and *Myosotis: Forget-me-not*,⁶⁾ a book compiled by many concerned people of the university and bereaved families. The two books are also precious materials that help us to carry on the Nagai



Figure 2. Dr. Takashi Nagai presenting a report on nuclear diseases at the Plenary Session of the Acta Medica Nagasakiensia, November 17, 1946 (courtesy of the estate of Dr. Kinichiro Hamasato)

spirit. Ms. Hisamatsu worked closely with Dr. Nagai until his death and even until her death dedicated her life to carrying on in his spirit.

Many of our predecessors who experienced the atomic bombings in Hiroshima and Nagasaki became absolutely opposed to wars and had a strong desire to abolish nuclear weapons. Still, preparation for and responses to radiation accidents and nuclear disasters are always in demand. However, we should admit that Japan failed to learn sincerely from the Chernobyl accident, the worst nuclear accident in history, which happened in the Soviet Union on April 26, 1986. Many people in Japan believed that a similar accident would never happen there, and they even underestimated the real need for radiation emergency medicine. In this context, nuclear energy came into greater use, and the number of industrial nuclear power stations across the country reached 54 before the Great East Japan Earthquake of 2011. The Fukushima accident revealed that the government, including Japan's Nuclear Safety Commission, had not fully prepared the tertiary radiation emergency medicine system. Although the atomic bombings and the power station accident cannot be compared at the same level, the situation was marked by short-sighted preconceptions and prejudices that associated nuclear accidents with atomic bombings, leukemia, cancer, and death. As terror and anxiety spread throughout the entire country, the medical staff involved in the crisis interventions to save

the situation presumably exhibited the Nagai spirit, with or without being aware of it.

An effective response to nuclear disasters requires shared ideas about disaster cycles, and these differ over time: before and in the midst of an accident, and during restoration and reconstruction efforts. At the time of a nuclear power station accident, the disaster-cycle approach needs to be taken: in addition to preliminary preparations and training based on the major premise that there is no absolute safety, education on radiation risk is required in ordinary times to raise people's familiarity with the idea of radiation protection. During an emergency response corresponding to a nuclear power station accident, which is an industrial crisis, measures should be taken to protect area residents, including strengthening the governance over crisis management, directing safety-first and indoor evacuations, and mitigating and preventing the public's exposure to radiation. Amid the avoidable confusion and chaos following an accident, advanced emergency medical care for radiation emergencies should be prioritized in accordance with the principle of Disaster Medicine, nevertheless by natural or man-made, intended to protect people's lives. In such a situation, radiation exposure management for the public at the time of the emergency should be passed down as a reference level for restoration and reconstruction efforts, considering deeply its benefit and risk of action plan. International institutions also recommend applying different ideas and reference levels from those of ordinary times to times of emergency.

Similarly, the responses to people exposed to high-dose radiation were limited following the Chernobyl accident, which led to many casualties. During the Tokaimura criticality accident, as was the case with the atomic bombing, Dr. Nagai pinpoints in his book the helpless response to acute radiation injuries due to exposure to a large amount of radiation. Once a nuclear accident happens in the modern risk society, ensuring the safety of medical personnel, the Self Defense Forces, the Fire and Disaster Management Agency, the police, and other concerned people becomes an urgent issue, and individuals are required to make judgments and decisions on their own based on their knowledge and

understanding of radiation risks and in reference to international standards of radiation protection during an emergency. In the meantime, however, a general view of the risks related to low dose/low dose-rate radiation exposure that is meaningful in terms of matters public exposure cannot be shared easily, according to my experiences in Chernobyl and Fukushima. To solve the problem, we must continue forward with disciplined and logical thinking and a firm belief in our own human capabilities.

In Japan, the issue of radiation exposure has spanned the decades, from Hiroshima and Nagashima to Fukushima and into the present. Despite the significant difference in reality between these incidents, to succeed and develop our experience and technology related to radiation emergency medicine, all of which was obtained as a result of these incidents, and to promote prepared responses to advanced radiation emergency medicine and public exposure medicine, we must acknowledge our responsibility, mission, and commitment to the movement now being established in Japan.

Discussion and summary

The purpose of the mini-review on countermeasures against nuclear disasters has been to describe the atomic bombing disaster and to refer to the lessons learned from it during the commemoration of the 110th anniversary of Dr. Nagai's birth. We can best do this by reminding those medical personnel and researchers, and nurses and health professionals who respond to today's nuclear disasters to refer to his book "*Atomic Bomb Rescue and Relief Report*". He wrote many other works, too, including *The Bells of Nagasaki*, which have been published as a complete collection.⁷⁾ In choosing to focus on the origin of his activities, that is his exposure to radiation following the atomic bombing, I am delivering to you observations focused on this book, written immediately following the atomic bomb disaster. The extreme form of response to life-threatening crises, whether they are accidents or unexpected natural or man-made and technological disasters has been witnessed in war and conflict, and the catastrophe caused by the atomic bombs dropped in Hiroshima and Nagasaki. The differences between the atomic bombing during World War II and

the nuclear disaster in modern Japan during a time of peace should be logically understood beyond emotions such as terror and anxiety over radioactivity and radiation. Keeping in mind the lessons learned from the Chernobyl accident in the former Soviet Union, which occurred during the Cold War, we can learn the logical differences and similarities with the Fukushima accident.

We should consider the possible responses to nuclear disasters based on the history of those societies affected by them; then we can see that the results of broad-ranging research in basic, clinical, and epidemiological fields. These have been successfully applied to and will contribute greatly to the responses offered to atomic bomb survivors, from acute radiation injuries due to exposure at the time of the bombing to the so-called after effects of exposure, including late-onset cancer risks and non-cancer risks.

In modern risk society, when a nuclear disaster occurs, the general public is subject to futile and unnecessary exposure, and there are wounded and sick people who require advanced medical care to deal with the radiation emergency. The role of nurses and health professionals is critically important when they encounter a nuclear disaster. The attitude medical personnel take during such an emergency has a great influence on their proper and prolonged response, and when considering later restoration and reconstruction efforts. In Japan, the current situation requires the restoration and strengthening of human capabilities to recover people's sense of security, in addition to tackling the issues of radiation risk management. This demands a shift from group risk assessment to individual risk management, and to the personal independence and dignity of recovering disaster survivors. During a mega industrial crisis, the organized response from the government and concerned institutions, so-called "Right Governance", is the top priority. We should be reminded that each of these organizations has enormous capabilities and that, beyond regular drills and preparation, individual workers' sense of resolution and decision-making skills have a great influence not only immediately after the crisis but also for a long period following it.

Finally, the basic spirit and concept of participating in nuclear disaster medicine that we have inherited from Hiroshima and Nagasaki has had a negative connotation in the past, as it is rooted in the history of the atomic bombings themselves. This means that what is done is done and all we can do is learning from our failures and the past, as doing so will lead to improved development and better security in ordinary times. These, in turn, will allow us to respond well to different phases of the disaster cycle and to secure the budget we need to provide this support. In front of the "Nyoko-do" Hall stands a monument inscribed with a quote from Dr. Nagai, "As long as my life goes on, I follow the path of exploring the truth." The establishment of an academic framework for uncovering the truth is closely related to disaster prevention and mitigation measures for those phenomena that cause radiation exposure. This will, undoubtedly, lead to a wide-ranging educational revolution and renewed awareness among concerned people about comprehensive risk management.

References

- 1) Website of the Division of Scientific Data Registry. Atomic Bomb Disease Institute, Nagasaki University. (Accessed December 15, 2018). <https://www-sdc.med.nagasaki-u.ac.jp/abcenter/nagai/index.html>
- 2) Yasuyama K. 完全版長崎原爆の記録 [Document of Nagasaki atomic bombing (full version)]. Tokyo Tosho Shuppan, Tokyo, 2007.
- 3) Akizuki T. 死の同心円 [Concentric circle of death]. 名著復刻 [Masterpiece reprinted] series. Nagasaki Bunkensha, Nagasaki, 2010.
- 4) Koji T. 長崎医科大学壊滅の日：救いがたい選択“原爆投下” [The day of demolition of Nagasaki Medical University-Unavoidable choice: Atomic bomb dropping]. Self-published, 1995.
- 5) Hisamatsu S, Kawashima M (ed.). 凜として看護 [Nursing solemnly]. Shunjusha Publishing Company, Tokyo, 2005.
- 6) Website of Nagasaki University 70th Memorial Ceremony Projects. Myosotis: forget-me-not. 忘れな草 (reprinted version only) (Accessed December 15, 2018). <http://www.med.nagasaki-u.ac.jp/med/hibaku70/event/wasurenasou.html>
- 7) Nagai T, Nagai T (監). 永井隆全集 3 卷 [Complete Works of Takashi Nagai Vols. 1-3]. San Paulo Publishing Company, San Paulo, 2003.