

The Planetary Health Imperative to Eradicate Nuclear Weapons

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“... from a health perspective—a proper understanding of what nuclear weapons will do invalidates all arguments for continued possession of these weapons and requires that they urgently be prohibited and eliminated as the only course of action commensurate with the existential danger they pose.” (UN General Assembly, 2016)

Existential Threats to Survival and Health

Among the myriad causes of death, illness, and suffering, it is those with potential to cause not only individual or mass death but disrupt the ongoing chain of life itself which can jeopardize the possibility of life for future generations that most demand priority and attention. Consequences of such cataclysmic proportions make intolerable the mere existence of danger that is preventable.

Until our sun expands into a red giant star in 6 billion or so years and makes the earth inhospitable, there are three existential challenges we must navigate collectively.

The first is collision of the earth with a celestial body, such as a large meteorite. Such collisions have been the main cause of previous major extinctions, like that of the dinosaurs. We may now be able to anticipate and avoid some such catastrophic collisions and should work collectively to improve these capabilities.

The second is environmental disruption, with degradation and depletion of vital resources and ecosystems; inadequately mitigated global heating posing the greatest such threat.

The third, more acute and less potentially reversible, is the danger of nuclear war. The World Health Assembly in 1983 identified nuclear weapons as “the greatest immediate threat to the health and welfare of mankind” (World Health Organization, 1983). Preventing use of nuclear weapons, by accident or design, necessitates their eradication; a necessary, urgent, and feasible precondition for securing planetary and human survival, health, and sustainability.

The latter two of these existential challenges are of recent and human origin, needing human solutions. Those of us alive since 1945 when nuclear weapons were first exploded, and more recently since evidence of human-induced climate disruption became unequivocal, are in all human evolutionary history the first generations

to face existential threats of our own collective making. While the enormous and unprecedented responsibility we bear is a daunting challenge and burden, it is also a precious gift. No people in all human history have had as great an opportunity as those alive now to avert harm and do good for humanity, and for all the current and potential future denizens with whom we share planet earth.

For each of these existential threats, the severity and pervasiveness of the potential impacts make the broader ecosystem frame of planetary health more appropriate than one limited to human health, even if viewed globally.

Health evidence and health professionals have played and continue to play a central role in work to control nuclear weapons. This work involves mobilization and coalition building within the health sector, and also necessitates expertise and wide collaborations well beyond the health sector. The health systems building blocks most germane to this work are information/evidence, resources (especially human), and governance/leadership. A number of elements of a systems approach have proven useful to the health contribution toward freeing our world from nuclear weapons, in particular dynamic, big-picture thinking, a broad ecological perspective of positive and resisting forces and actors, an understanding of the non-linearity of political and social change, and the roles of focused interventions, critical mass, and tipping points. Applying the lessons of what has worked in efforts to control and eliminate other indiscriminate and inhumane weapons has also been key. This chapter discusses approaches and lessons useful in what has become known as the Humanitarian Initiative on nuclear weapons developed over the last decade, and especially the first international legal instrument to prohibit nuclear weapons and provide a framework for their elimination: the 2017 UN Treaty on the Prohibition of Nuclear Weapons.

Nuclear Weapons and Fissile Materials

Nuclear weapons are by far the most destructive, indiscriminate, persistently toxic weapons ever invented.

The nuclear fission processes inside an atomic weapon and a nuclear reactor are fundamentally similar, and both increase the radioactivity present in the starting materials millions of times. In a thermonuclear (or hydrogen) bomb, highly enriched uranium (HEU) and/or plutonium undergoes fission, producing immense heat and pressure which enable isotopes of hydrogen (deuterium and tritium) to fuse, releasing vast, essentially limitless amounts of energy. This is the main process driving the sun. Single nuclear weapons have been detonated with more than four times the destructive power of all explosives used in all wars throughout human history.

Fissile materials are both toxic and weapons-usable over geological periods that make the time frames of human institutions irrelevant. Therefore, a sound approach is based on primary prevention and the inherent dangers of nuclear weapons and fissile materials. The custodial political leaders, their intentions, policies, and personalities, alliances, and governments, the areas within their jurisdiction, the functioning of governance and regulatory institutions, on the other hand, can transform overnight.

The current global stockpile of HEU is estimated at 1,330 tons, and for plutonium already separated from spent reactor fuel, 536 tons (International Panel on Fissile

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Materials, 2021). With modern US nuclear weapons known to contain an average of 4 kilograms (kg) of plutonium (or 12 kg of HEU), current fissile material stocks are sufficient to reconstitute the current global nuclear arsenal of 13,100 weapons many times over (Kristensen & Korda, 2021). Hence, ending production of weapons-usable materials, eliminating them wherever possible, and storing the rest as securely as humanly possible are key to achieving and sustaining a world free of nuclear weapons.

The Effects of Nuclear Weapons

An understanding of the effects of nuclear weapons is a crucial underpinning for all considerations and policy relating to them. Evidence of the true extent of the effects of nuclear weapons has frequently not been collected, or has been covered up, misrepresented, or disregarded by governments, victim to the myths that nuclear weapons are just weapons like any other, only larger, and can be used to serve legitimate military purposes and enhance security. The reality is vastly different. No humanitarian response, reconciliation, or recovery is possible after a nuclear war. The concept of “winners” would be meaningless; there would be only losers.

(i) Acute effects

Nuclear weapons produce an enormous blast wave that causes trauma both directly (such as lung trauma and ear drum rupture) and indirectly through powerful winds which can turn objects, including people, into missiles. Intense heat causes direct vaporization, incineration, and burns and ignites anything flammable over a large area. A defining feature of nuclear weapons is the release of huge amounts of radioactivity in the initial pulse as well as through radioactive fallout, containing hundreds of different radioisotopes with half-lives ranging from fractions of a second to millions of years. Fallout is dispersed by wind and water over great distances, eventually worldwide. Ionizing radiation causes acute multi-organ toxicity (acute radiation sickness) at high acute doses, and in the long term any level causes dose-related genetic damage and lifelong subsequent increased risk of cancer and chronic diseases. Genetic damage may be inherited by future generations, who would also be at further risk through living in a radioactively contaminated environment.

The electromagnetic pulse (EMP) from a single high-altitude nuclear explosion would cover a continental size area with voltage a million times greater than lightning. This would disrupt the vast array of not specifically protected electrical and electronic equipment on which the infrastructure of modern societies is highly dependent, including water and electricity supply, telecommunications, computer systems, transport networks, medical equipment, traffic lights, banking, and most commerce and trade (Ruff, 2013).

While the average size of the weapons in the global nuclear arsenal is 200 kilotons (kt) high explosive equivalent, thirteen times the size of the Hiroshima bomb, the largest currently deployed nuclear weapons contain 5 million tons (Mt) of high explosive equivalent for blast. Within a thousandth of a second, conditions akin to the center of

the sun would be produced: 100 million °C and 100 million atmospheres of pressure in a fireball which would rapidly expand to 1.8 kilometers (km) across. Within 4.7 km in every direction, winds of 750 km/h and a blast wave over 140 kPa would destroy all buildings and vaporize the upper layer of the earth. To 7.5 km in every direction, winds of 460 km/h and blast pressures of 80 kPa would break apart concrete and steel buildings and vaporize aluminum. For 12.3 km in every direction, asphalt would melt and windows fragment into more than 4,000 projectile glass shards per square meter (m²). Stretching 22.6 km in every direction, over an area of 1605 km², everything flammable would ignite—wood, vegetation, paper, cloth, plastics, petrol, oil from ruptured tanks, and cars; further fueled by ruptured gas pipes, downed electricity lines, and leaking chemicals. Within half an hour, hundreds of thousands of fires would coalesce into a giant firestorm 45 km across, with temperatures of more than 800 °C, sucking in air and creating winds of more than 320 km/h, consuming all available oxygen (Ruff, 2013). Shelters would become crematoria and every living thing would die within this fire zone.

Streets would be impassable. There would be no ambulances, fire engines, or police, no power or communications or functioning hospitals. The vast majority of injured and burnt people would die alone without any human comfort or relief from their agonizing pain (World Health Organization, 1987).

(ii) Climate impacts and nuclear famine

There have been important new findings regarding ionizing radiation health effects in recent years, in the direction of greater health consequences than previously estimated (Ruff, 2017). However, it is in relation to the impacts of nuclear war on climate, agriculture, and nutrition that scientific advances of the greatest moment have been made in the past fourteen years. It is not just large-scale nuclear war between Russia and the United States that poses a global threat. A series of studies have shown that a localized, regional nuclear war utilizing a tiny fraction of the global nuclear arsenal would also have catastrophic worldwide effects.

Nuclear weapons are extremely efficient at igniting simultaneous fires over large areas, which would rapidly coalesce and loft large volumes of sooty smoke into the stratosphere. The scenario most frequently studied and recently updated (Toon et al., 2019) is nuclear war between India and Pakistan. These countries have fought four wars and many skirmishes since their partition in 1947. The most recently studied scenario assumes that in 2025, each country will possess 250 nuclear weapons, and 250 are used in a war between them. This number constitutes less than 2% of the current global nuclear arsenal and less than 1% of its explosive power. The direct effects in South Asia are catastrophic. Depending on whether the weapons used had yields of fifteen (Hiroshima-size), 50 or 100 kt, between 50 and 125 million people would die from the early direct effects of the explosions, fires, and local radiation.

The global consequences would, however, be far more devastating. Cities ignited by the nuclear explosions would loft dark smoke containing between 16.1 million tons (for 15 kt warheads) and 36.6 million tons (for 100 kt warheads) of black carbon high into the upper atmosphere. Previously, three teams of climate scientists using

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three different climate models and making conservative assumptions each showed significant drops in average surface temperature, sunlight, and precipitation across the globe, with the effects lasting for over a decade for a smaller scenario involving 100 15kt nuclear explosions (Mills, Toon, Lee-Taylor, & Robock, 2015). While the fuel density of modern cities and industrial areas varies, there is nothing specific to India/Pakistan about such a scenario, and urban populations and fuel densities are tending to rise worldwide. In the Toon 2019 study, average global land temperatures decline by as much as 4–8C. By comparison, the Last Glacial Maximum 20,000 years ago saw a decline in temperatures of 3–8C. Following nuclear war, ice-age conditions would develop within a few weeks.

This climate disruption would in turn profoundly reduce food production. For a scenario involving 100 15 kt explosions, producing 5 million tons of smoke, considering only the impact of colder temperatures, reduced sunlight, and precipitation decline, global grain crops would reduce by 20% for the first five years and 10–15% for the second five years (Toon et al., 2017), with much larger declines at higher latitudes.

Adequate human nutrition cannot be sustained in the face of widespread decline of food production of this magnitude. Total world grain reserves typically amount to 60–120 days of global consumption and would not begin to offset the shortfall over a decade or more (Toon et al., 2017). Furthermore, the United Nations Food and Agriculture Organization (FAO) estimates there were 768 million people in 2020 who are already chronically undernourished, and a rising number of people—2.37 billion—currently facing moderate or severe food insecurity (Food and Agriculture Organization, 2021). In addition, a further 300+ million people who receive adequate nutrition today live in countries highly dependent on food imports, which would quickly dry up following a nuclear war. Conservatively estimated, without taking account of land polluted by radiation and toxic chemicals, dramatically increased ultraviolet (UV) radiation harmful to plants and animals both on land and in water, disruption to trade and agricultural inputs including seed, fertilizer, fuel, pesticides, etc., or the disease epidemics and social conflict that inevitably accompany famine, around 2 billion people would starve, following a regional nuclear war involving 0.7% of the global arsenal and less than 0.1% of its total yield (Helfand, 2013).

A recent study (Toon et al., 2019) estimates reductions in net primary productivity (NPP) for the range of weapons yields already described. This is a measure of broad ecological health, reflecting the amount of carbon dioxide (CO₂) converted to plant matter, after accounting for plant respiration. It is therefore a proxy envelope for the maximum amount of food which could be harvested. NPP would decline by 15–30% on land and 10–20% in the oceans over several years. This is comparable to the total amount of food and fiber currently used by humans. In some densely populated regions of Europe, south and east Asia, humans appropriate 63–80% of NPP, and people in most of India, eastern China, parts of the Middle East, and equatorial Africa consume more than 100% of local NPP, with consequently little or no margin to cope with the multiyear productivity loss that would follow a regional nuclear war anywhere in the world.

Large-scale war between the United States and Russia would be far worse. A war involving the strategic (long range) weapons now deployed would put 150 million tons of black carbon in the upper atmosphere, and drop temperatures around the

world by 8–10 °C. In the interior regions of North America and Eurasia, temperatures would fall by 25–30 °C for more than a decade. In temperate regions of the northern Hemisphere, temperatures would fall below freezing for part of every day for at least two years (Coupe, Bardeen, Robock, Toon, 2019). Food production would cease and the vast majority—perhaps all—of the human race would starve (Helfand et al., 2016).

This evidence of severe global impacts from even a limited regional nuclear war involving a tiny fraction of the world stockpile means that all nuclear arsenals, not only those of Russia and the United States, pose a global danger. During most of the Cold War it was argued that the risk of “mutually assured destruction” would keep the peace between rationally and reliably governed nuclear-armed rivals. However, we now know that use of nuclear weapons would be suicidal, even without highly probable nuclear escalation and retaliation, resulting in “self-assured destruction” (Toon et al, 2017). Nuclear weapons are effectively global suicide bombs.

The Growing Risk of Nuclear War

The current international security landscape is alarming. Relations between United States/NATO and Russia are at their lowest ebb since the end of the Cold War, with Russian annexation of Crimea, and an increase of aggressive threats, military exercises, and deployments. The arms control treaties that have helped prevent nuclear catastrophe for the last half century are being progressively dismantled. The signature disarmament treaty that ushered in the end of the Cold War, the Intermediate Nuclear Forces Treaty, was abandoned in 2019. The Anti-Ballistic Missile Treaty and Open Skies Treaty have also been abandoned. In early 2021, a new United States administration joined Russia in extending the New Strategic Arms Reduction (START) Treaty for five years, two days before the treaty would otherwise have expired. This is the only remaining constraint on Russian and US nuclear weapons, together possessing 90% of the global total. While exploratory Russian–US talks on nuclear weapons resumed in 2021, both sides are developing new nuclear weapons and lowering the threshold for nuclear war.

Tensions simmer between China, United States, Japan, and others in the South China Sea. Almost weekly skirmishes along their disputed border, a continuing nuclear arms race, weak security of nuclear weapons, and policies envisioning early use of nuclear weapons, highlight the real danger of armed conflict turning nuclear between India and Pakistan. The welcome signs in recent years of rapprochement and dialog replacing irresponsible escalating nuclear threats between DPRK (North Korea) and the United States are reversing. The landmark agreement which saw unprecedented and effectively verified constraints on Iran’s nuclear program is unraveling after the United States walked away from the agreement. The danger of nuclear weapons detonations as a result of cyberattack is growing (Helfand et al., 2016). A climate stressed-world is already witnessing a sharp increase in the number of internationalized armed conflicts over the last decade (World Bank, 2018), many involving nuclear-armed states and thereby posing growing risks of nuclear escalation.

Meanwhile, all nine nuclear-armed states are committed not only to indefinite retention of their nuclear arsenals, but all are investing large sums—together over US\$

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105 billion annually—in modernizing them, developing new weapons with new capacities, making them more accurate and “usable.”

No wonder then that the thirteen Nobel Laureates and other custodians of the Doomsday Clock, along with most authoritative others, assess the dangers of nuclear war to be as high as they have ever been, and growing. In January 2018 the hands of the Clock were moved forward to two minutes to midnight, as close to midnight as they have been since 1953, when both the United States and USSR in rapid succession tested thermonuclear bombs. The hands were kept there in 2019. In January 2020, they were moved to 100 seconds to midnight, closer than they have ever been (Science and Security Board, 2020). They said:

Humanity continues to face two simultaneous existential dangers—nuclear war and climate change—that are compounded by a threat multiplier, cyber-enabled information warfare, that undercuts society’s ability to respond....

In the nuclear realm, national leaders have ended or undermined several major arms control treaties and negotiations during the last year, creating an environment conducive to a renewed nuclear arms race, to the proliferation of nuclear weapons, and to lowered barriers to nuclear war. Political conflicts regarding nuclear programs in Iran and North Korea remain unresolved and are, if anything, worsening. US–Russia cooperation on arms control and disarmament is all but nonexistent.

In 2021, the hands of the clock remain at 100 seconds to midnight.

Experience with Other Indiscriminate, Inhumane Weapons

Substantial progress has been made toward the control and elimination of other types of weapons with inevitably inhumane and indiscriminate effects: biological and chemical weapons, antipersonnel landmines, and cluster munitions. Although the histories differ, a common element which has proven effective can be summarized as stigmatize, prohibit, and eliminate. In each case, incontrovertible evidence that the respective weapons, however used, would have indiscriminate and inhumane effects provided the basis for codifying their rejection in an international treaty enshrining a consistent standard for all states. Prohibiting unacceptable weapons does not *per se* eliminate them, but it provides the necessary justification and basis for progressive work toward eliminating weapons deemed unacceptable under international law. Indeed, no other approach has proven effective; no weapon has been eliminated without first being prohibited.

While work remains to be done to eliminate each type of prohibited weapon, and setbacks occur, each type of prohibited weapon is now less often produced, deployed, traded, stockpiled, used, and justified.

Importantly, once established, norms become stronger over time and influence even states not formally signed up to the relevant treaty. For example, until President Trump in early 2020 signaled a return to the US use of landmines, the United States had in 2014 put in place prohibitions on landmine production and use and had been

proudly declaring itself in international forums to essentially be in compliance with the landmines ban. It has also ceased production of cluster munitions, even though it opposed and hasn't signed either treaty.

When use of chemical weapons in Syria was confirmed by a UN investigation in 2013, Russia and the United States forced the Syrian regime to join the Chemical Weapons Convention, and Syria's declared stockpile of 1,260 tons of chemical weapons and precursors was destroyed in 2014.

All countries except for North Korea have stopped nuclear test explosions, even though the Comprehensive Test Ban Treaty negotiated in 1996 has not yet entered into force because key nuclear-capable countries have not yet joined.

Until recently, it was a gaping anomaly that this proven approach had not been applied to the last remaining weapon of mass destruction to be outlawed: nuclear weapons, the most destructive of all.

The Current Status of Nuclear Weapons and Disarmament

While the number of nuclear weapons has reduced from 70,300 in 1986 to an estimated 13,100 in August 2021, and with increasing accuracy explosive yields have trended downwards, their destructive potential is not significantly reduced. This is because of enormous redundancy in destructive capacity ("overkill"), increased understanding of the severity of their effects, and the fact that "smaller" nuclear weapons—in the tens to hundreds of kT range—distribute destruction more efficiently. In cities such weapons produce 100 times as many acute fatalities and 100 times as much smoke from fires per kt of explosive yield as mT-range weapons. (Toon et al., 2007).

The pace of nuclear reductions has slowed significantly since the 1990s, and China, India, North Korea, Pakistan, Russia and the United Kingdom are increasing their arsenals. Almost 4,000 warheads are operationally deployed, of which about 2,000 US, Russian, British, and French warheads are on high alert, ready for use within minutes (Kristensen & Korda, 2021).

The unprecedented threat posed by nuclear weapons was recognized in the very first resolution of the United Nations General Assembly (UNGA) in January 1946, calling for the elimination of atomic weapons. The preamble of the 1970 nuclear non-proliferation treaty (NPT) opens, "Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war . . ." The obligation to pursue effective measures toward nuclear disarmament enshrined in Article 6 is a shared responsibility of all 190 NPT signatory states and part of customary international law.

The International Court of Justice, the world's highest legal authority, in its 1996 Advisory Opinion on nuclear weapons confirmed that under the UN Charter, if the use of force in a given case is illegal then the threat to use such force will likewise be illegal, that is that the threat—the basis of policies of nuclear deterrence—and the use of nuclear weapons "stand together" legally. The Court unanimously ruled that there exists an obligation not only to pursue in good faith but to bring to a conclusion negotiations leading to nuclear disarmament.

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Yet there are currently no negotiations underway or planned between nuclear-armed states to reduce warheads or curtail nuclear operations and modernizations, nothing to replace the erosion of the existing treaty constraints on nuclear proliferation described earlier, and between them there is no proposed or agreed process to fulfil their half-century-old binding legal obligation to disarm.

In this bleak landscape of nuclear modernization, failure of disarmament and growing risk of nuclear war, the negotiation and adoption in 2017 of the UN Treaty on the Prohibition of Nuclear Weapons by the majority of the world's states which neither possess nor assist in preparations for possible use of nuclear weapons stands as a beacon lighting the only currently defined pathway toward the eradication of nuclear weapons.

What's in the Treaty on the Prohibition of Nuclear Weapons (TPNW)?

The mandate provided in December 2016 by the UNGA was "to negotiate a legally binding instrument to prohibit nuclear weapons, leading toward their total elimination." The treaty was adopted at the UN in New York on July 7, 2017, by a vote of 122 to 1.

Drawing on other disarmament treaties, the treaty provides the first categorical and comprehensive prohibition of nuclear weapons and activities enabling their possession, deployment, and possible use (UN General Assembly, 2017). Its preamble articulates deep concern about the catastrophic humanitarian consequences of any use of nuclear weapons, the consequent need to eliminate them completely, and guarantee that they never again be used under any circumstances. It states that the risks posed by nuclear weapons threaten the security of all humanity and therefore all states share the responsibility to prevent any use. It recognizes that the consequences of nuclear weapons use cannot be adequately addressed, pose grave implications for human survival, the environment, socio-economic development, food security, and the health of current and future generations. For the first time in a nuclear disarmament instrument, tribute is paid to survivors of nuclear use (*hibakusha*) and testing, and the disproportionate impact of nuclear weapons on women and girls, and on indigenous peoples, are recognized.

The treaty commits each state party never under any circumstances to develop, test, produce, manufacture, otherwise acquire, possess, or stockpile nuclear weapons. It prohibits the transfer, use, or threat of use of nuclear weapons, and to assist, encourage, or induce, in any way, anyone to engage in any prohibited activity.

The treaty is crafted to enable states that own nuclear weapons, owned them previously, or have them stationed on their territory, to join. It requires that nuclear weapons, nuclear weapons programs and facilities be eliminated under verifiable, irreversible, and time-bound plans to be agreed with states parties. The details of these elimination regimes require the active participation of the states possessing the weapons, but the treaty provides a clear framework and non-discriminatory principles for these regimes.

Second, this treaty, more than any other nuclear disarmament treaty, has an unequivocal basis in humanitarian evidence and norms. It builds directly on the evidence-based conclusions of the three first-ever intergovernmental Humanitarian Impacts of Nuclear Weapons conferences in Norway, Mexico, and Austria from 2013 to 2014 (Europe Integration, 2014a). At the end of the Vienna conference, attended by 158 states, Austria launched the Humanitarian Pledge to work to fill the legal gap for the prohibition and elimination of nuclear weapons (Europe Integration, 2014b). It was joined in this pledge by 126 other states. Health evidence on the catastrophic consequences of any use of nuclear weapons, the impossibility of any effective health and emergency response for the victims of nuclear weapons, and the imperative for prevention, as well as evidence from leading climate scientists on the nuclear winter and famine that would follow even a regional nuclear war was presented and updated at each of the humanitarian conferences. This evidence was unchallenged. It provided an authoritative evidence base for the process of securing a negotiating mandate and for the treaty negotiations themselves. Health evidence is central in the treaty's preamble, which outlines the basis and purpose of the treaty.

Third, the level of participation of civil society was unprecedented in the nuclear field. Academic and other civil society experts, including in public health and climate science, made important contributions to the negotiation of the treaty. The International Committee of the Red Cross (ICRC), with its status as partner to governments in humanitarian assistance and a key custodian of international humanitarian law (law regulating armed conflict), also made seminal contributions on behalf of the world's largest humanitarian organization to a strong final treaty.

Fourth, those directly harmed by nuclear weapons had prominence unprecedented in intergovernmental forums regarding nuclear weapons. Japanese *hibakusha* and nuclear test survivors grounded discussions in the lived experience of what nuclear weapons actually do, reminding diplomats why their work mattered, and why concluding the ambitious goal of an effective treaty by the end of the negotiating mandate on July 7, 2017 was of utmost importance. Their prominent participation lent the process legitimacy, moral weight, and humanity. Nuclear weapons can be daunting, difficult, and uncomfortable to grasp, remote from everyday human experience. The courageous testimony of survivors combined powerfully with scientific evidence to make clear what nuclear weapons do and the urgent imperative to eradicate them.

Fifth, the negotiation of the treaty through the UNGA was highly effective. This was the first time in twenty-one years that a nuclear disarmament treaty was negotiated in the United Nations. Crucially, its most inclusive and fundamental organ, the General Assembly, is able to decide substantive matters by two-thirds majority vote if consensus cannot be achieved. This is in contrast to the NPT review conferences and the UN Conference on Disarmament (CD), which are both shackled by a requirement for consensus, meaning lowest common denominator or no agreed outcomes (and explains why the CD has been unable to agree even on an agenda since 1996). In the UN Security Council, each of five nuclear-armed permanent members is able to veto any decision. Being adopted in the most inclusive global forum by such an overwhelming majority also affords the treaty moral and political credibility.

Not only was the UNGA negotiating process effective, it was efficient. This ambitious treaty was able to traverse from negotiating mandate to adopted text in just eight

months, with only four weeks of face-to-face negotiations. This reflected both a lack of opposition in the room by nuclear-armed and nuclear-dependent states opposed to the treaty, which boycotted the negotiations, and a remarkable level of goodwill on the part of negotiating states.

The treaty in both process as well as substance thus represents a seismic shift in bringing global democracy to nuclear disarmament, and in asserting the interests of shared humanity. It bodes well for other negotiations that might be undertaken in the UNGA. This disruption of the dominance of nuclear-armed states is likely one of the reasons why they have opposed the treaty so vociferously.

Sixth, fierce political and economic pressure has been brought to bear on states supporting banning nuclear weapons by nuclear-armed states, particularly France, Russia, the United Kingdom, and the United States. A number of supportive states, particularly smaller and poorer nations in Africa, Latin America, South East Asia, and the South Pacific, were successfully pressured not to vote or to abstain. However, the majority supporting the treaty was so overwhelming that nuclear-armed states failed to derail its negotiation or adoption.

Seventh, the boycott of the negotiations by all nuclear-armed states, and all additional states that claim protection from US nuclear weapons except for the Netherlands (not supportive but forced to participate by public and parliamentary pressure), throws into sharp relief their current commitment to retaining, modernizing, and continuing to threaten use of their nuclear arsenals, rather than fulfilling their obligation to eliminate them. These governments claim to be good international citizens, to respect and promote human rights and the rule of law, to support disarmament, and have joined treaties that prohibit and provide for the elimination of other inhumane and indiscriminate weapons. Boycotting multilateral negotiations to ban the worst weapons of mass destruction and opposing the resultant international treaty, makes clear the shortfall in their sincerity and consistency to fulfill their NPT Article 6 obligation "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament."

Box 21.1 identifies measures supporting nuclear disarmament ripe for engagement of health professionals, which are relevant for the vast majority of the world's states which don't possess nuclear weapons.

Health Evidence and Global Health Partnership Played a Key Role in Achieving the Ban Treaty

Peak global health bodies have long identified the health imperative for eradication of nuclear weapons. The World Federation of Public Health Associations (WFPHA) General Assembly in 1993 recognized "that the continued existence of nuclear weapons poses an unacceptable risk to global health and the global environment," and in 1997 reaffirmed its call for the abolition of nuclear weapons.

The World Medical Association (WMA) in its Statement on Nuclear Weapons updated in 2018 "joins with others ... including the Red Cross and Red Crescent movement, International Physicians for the Prevention of Nuclear War, the International

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Box 21.1 Selected measures to stigmatize, prohibit, and eliminate nuclear weapons which can be taken by the 184 UN member states without nuclear weapons

Promptly sign, ratify, or accede to, and implement the Treaty on the Prohibition of Nuclear Weapons. This includes measures to implement their treaty obligations, including through domestic law, regulation, and penal sanctions. National legislation should make it a criminal offence for anyone within their jurisdiction to engage in the development, production, testing, acquisition, stockpiling, transfer, deployment, threat of use, or use of nuclear weapons, as well as assistance, financing, encouragement, or inducement of these. They are obliged to cooperate with other states parties to facilitate implementation of the treaty, work for universal adherence of all states to the treaty and undertake feasible measures to assist the victims of nuclear use or testing and remediate environments so contaminated.

Adopt nuclear weapons-free military policies. The states which do not own nuclear weapons but claim protection from US or Russian nuclear weapons and collaborate in preparations for their possible use can adopt policies which preclude their participation in threat or use of nuclear weapons. This includes the twenty-seven non-nuclear-armed members of NATO, Australia, Japan, South Korea, Armenia and Belarus.

Adopt policies to preclude government and private investment in companies producing nuclear weapons.

End production of separated plutonium and highly enriched uranium (HEU), which can be used to build nuclear weapons. Any stocks of plutonium or HEU should where possible be eliminated or stored as securely as possible in centralized locations under international control.

Phase out nuclear power and accelerate building renewable energy systems and energy efficiency. Nuclear power in addition to its other hazards requires uranium enrichment and creates plutonium, both of which can be used for nuclear weapons.

Close or internationalize uranium enrichment plants (which can readily be used to produce HEU). Cease development of new uranium enrichment modalities (such as laser enrichment) which aggravate dangers of nuclear weapons proliferation.

Develop and deploy accelerators rather than nuclear reactors to produce radioisotopes for medical and scientific use.

Campaign to Abolish Nuclear Weapons, and a large majority of UN member states, in calling, as a mission of physicians, on all states to promptly sign, ratify or accede to, and faithfully implement the Treaty on the Prohibition of Nuclear Weapons; and Requests that all National Medical Associations join the WMA in supporting this

Declaration, ... educate the general public and to urge their respective governments to work urgently to prohibit and eliminate nuclear weapons ..."

In April 2016, International Physicians for the Prevention of Nuclear War (IPPNW), was joined by WFPHA, the WMA, and the International Council of Nurses (ICN) in submitting to a UNGA Working Group a joint Working Paper (UN General Assembly, 2016). It details the planetary health imperative to ban and eliminate nuclear weapons. This unified call by leading global health professional federations, reinforced by joint op-eds in international media and in-person testimony, proved influential in the Group recommending to the UNGA that a treaty prohibiting nuclear weapons and providing for their elimination would be the next best nuclear disarmament step the world could take. This led to the UNGA mandate for the treaty negotiations, supported by over 120 states, a voting majority of more than three to one. Every opportunity was taken to publish further op-eds and submit further joint submissions, commentaries, and working papers, and provide oral testimony to the UNGA and then the treaty negotiating conference, strongly supporting a ban treaty on public health grounds. This united and authoritative call and active engagement by the world's most prominent international health federations mattered. Key diplomats have made clear the value of these submissions, and some of the elements so proposed are reflected in the treaty text.

Responsibilities of Health Professionals in the Eradication of Nuclear Weapons

A Chatham House Research Paper by Lewis et al. (2017) describes nuclear disarmament as the missing link in multilateralism: a blind spot. They consider how in relation to many spheres of international concern and responsibility—including development, climate change, public health, humanitarian action, international law, gender issues, protection of cultural heritage, and cybersecurity—all that has been achieved toward a safer and more secure world is in jeopardy "owing to the international failure to address nuclear disarmament and non-proliferation effectively." This failure "puts everything else at risk." They argue that "all those who are concerned about the survival and the betterment of humanity need to be equally concerned about nuclear weapons and nuclear disarmament." They urge that "[p]rogress on nuclear disarmament should be factored into monitoring progress on the SDGs" (Sustainable Development Goals).

All other human achievements, progress and efforts including in health could come to naught if we do not succeed in eradicating nuclear weapons before they are again used. There is only one acceptable answer to the stark, binary choice humanity faces: will it be the end of nuclear weapons, or the end of us? Health evidence, collaboration, and advocacy helped deliver and inform the landmark UN Treaty on the Prohibition of Nuclear Weapons, and a campaign coalition initiated by a medical federation was the major civil society partner contributing to this achievement (see Case Study). These contributions continue a long and proud tradition of action by health professionals to encourage movement away from the nuclear precipice. Such

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work helped end nuclear test explosions in the atmosphere, and helped governments step back from the brink and end the Cold War (Helfand et al., 2016; Forrow, Ruff, & Thurlow, 2018).

Case study—The International Campaign to Abolish Nuclear Weapons (ICAN)

ICAN was born in 2006 in Melbourne, Australia, and launched in 2007, out of dismay and frustration at the continuing failure to progress nuclear disarmament, alongside the inspiration provided by the success of the International Campaign to Ban Landmines in working initially with a small number of governments of small and medium-sized countries, to achieve a treaty banning landmines five years after its formation. This occurred despite the opposition of large and powerful users and producers of these weapons, such as China, Russia, and the United States.

ICAN was founded and initially developed by the Medical Association for Prevention of War (MAPW) on behalf of and in close collaboration with the international medical federation International Physicians for the Prevention of Nuclear War (Nobel Peace Prize 1985), of which MAPW is the Australian affiliate. ICAN was conceived as an outreach and coordination vehicle for more unified work around a clear focus in the diverse civil society movement for nuclear disarmament. IPPNW took responsibility to host and build the campaign until it could flourish independently. IPPNW is now one of ten organizations comprising the ICAN International Steering Group. By mid 2021, ICAN had become a campaign coalition of 607 diverse partner organizations in 106 countries. It served as the civil society coordinator for each of the three international conferences on the humanitarian impacts of nuclear weapons (2013–2014). ICAN went on to be the main global civil society coordinating partner working with governments to achieve the Treaty on the Prohibition of Nuclear Weapons, and then for the treaty's entry into force and implementation (Ruff, 2018b).

ICAN's principles, formulated early, have served the campaign well:

- Building on the experience of the treaties banning biological and chemical weapons, landmines, and cluster munitions; a clear, compelling and simple vision—eradication of nuclear weapons through a treaty/treaties to prohibit and eliminate them;
- A flexible and organizationally simple and lean campaign coalition model, making it easy and without cost for organizations to join as partners; respectful of and building on rather than competing with or duplicating existing organizations;
- As globally inclusive as possible;
- Involving diverse people, especially including young people, whose consciousness is post-Cold War and awareness of nuclear weapons often low;

- Coordinated messages, strategies, and engaging materials to make it as easy as possible for organizations around the world to work in a cohesive way;
- Balancing horror, humor, and hope in focusing as the basis for ICAN's work on the unacceptable catastrophic humanitarian impacts of nuclear weapons and the urgent humanitarian imperative for their prohibition and elimination. Scientific including health and climate evidence and advocacy based on this evidence are thus central to ICAN's work;
- Giving prominence to the lived human experience and voices of survivors of the nuclear bombings in Japan (*hibakusha*) and nuclear test explosions worldwide;
- Working both with governments, and to mobilize the public.

A key shift in strategy emerged in 2009–2010 in recognition that there was foreseeably no prospect of success for nuclear disarmament measures which depend on nuclear-armed states, given that none of these states were (or are) currently serious about disarmament. Therefore, breaking the logjam in nuclear disarmament depends on states free from nuclear weapons. These cannot eliminate weapons they don't possess, but they could fill the "legal gap" by unequivocally making nuclear weapons illegal, if they utilized a process which could not be blocked or vetoed by nuclear-armed states or their nuclear-dependent allies. This approach is similar to that used successfully for the landmine and cluster munitions ban treaties, where negotiations (outside the UN) were led by states without the respective weapons, but was new in the nuclear field.

ICAN was awarded the Nobel Peace Prize for 2017 "for its work to draw attention to the catastrophic humanitarian consequences of any use of nuclear weapons and for its ground-breaking efforts to achieve a treaty-based prohibition of such weapons" (The Norwegian Nobel Committee, 2017).

The treaty provides a powerful new tool in the essential ongoing work to eradicate weapons which daily jeopardize our future by risking indiscriminate nuclear violence. Health evidence and advocacy by health professionals to remove this most acute existential threat to global health and survival is as vital as ever (Ruff, 2018a). Box 21.2 and Table 21.1 outline some relevant public health principles and opportunities for health action, needed both within and beyond the health sector. The tools and approaches described which helped to achieve the historic first treaty to outlaw the world's most dangerous weapons must now be built upon and extended to complete the urgent, feasible, and necessary task to eradicate nuclear weapons. Evidence, its implications, advocacy based on these, applying the lessons of history of what has worked, building broad civil society coalitions around focused goals, working effectively with enlightened governments—local, regional, and national—divestment from companies profiting from building the worst weapons of mass destruction (Snyder, 2022), persistent and dedicated health professionals thinking and acting outside the box, will all be needed to complete the task of stigmatizing, prohibiting and eliminating nuclear weapons.

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Box 21.2 Some public health principles relevant to the eradication of nuclear weapons

Use evidence-based communication and advocacy in support of a clear, compelling goal

Build wide collaborations and coalitions between health professionals, and with other professions and spheres of activity

Find and nurture champions—diverse in culture, age, gender, location, expertise, natural constituencies

Give prominence to the voices and lived experience of those who have suffered most from nuclear weapons—survivors of Hiroshima and Nagasaki and nuclear test explosions worldwide

Seek to make universal vulnerability to nuclear weapons a basis for promoting nuclear weapons eradication as a shared responsibility; a necessary part of everyone/every organization's business, even if it is not their core business; and make it as easy as possible to contribute to a collective effort in a coordinated way

Norms and social acceptance or rejection of products and behavior can be influential

Legislation can be as much a step in a process as an end in itself

Use common criteria for health priorities to help overcome the continuing historic neglect of the existential threat posed by nuclear weapons:

- the magnitude of the problem/threat/consequences—for the most acute existential threat of human making to planetary health, no level of risk can be acceptable or sustainable
- the preventability of the threat
- the availability of opportunities and tools for action

Table 21.1 Selected opportunities for health professionals to progress the eradication of nuclear weapons

Field of activity	Examples of public health contributions	Opportunities for further contributions by health professionals
Building, updating, and communicating the evidence base on health impacts of nuclear weapons	Expert reports by WHO, national medical associations, the International Council of Scientific Unions, national academies of science, and other scientific bodies	Existing reports need updating and follow-up; very few have been updated since the 1980s, e.g., the last detailed WHO report on the effects of nuclear war on health and health services dates from 1987 Urge governments and national expert bodies to examine effects on their population and region of the climatic and nutritional effects of nuclear war

(continued)

Table 21.1 Continued

Build collaborations among health professionals	2016–2017 joint op-eds and working papers submitted to UN Working Group on nuclear disarmament, UN General Assembly and ban treaty negotiations by International Physicians for the Prevention of Nuclear War (IPPNW), International Council of Nurses (ICN), World Federation of Public Health Associations (WFPHA), and World Medical Association (WMA)	Promote understanding and action regarding the need to secure a stable and hospitable climate, by preventing runaway global heating as well as a precipitous ice age caused by nuclear war Engage additional national and international associations of health professions in policies, statements, submissions, articles, etc., and other educational and advocacy work regarding the planetary health imperative to eliminate nuclear weapons, and urging all governments to join the Treaty on the Prohibition of Nuclear Weapons
Health professional education	Extensive resources available at: http://www.ippnw.org/resources-abolition-nuclear-weapons.html ; Resources on climate and famine effects of nuclear war compiled by Professor Alan Robock: http://climate.envsci.rutgers.edu/nuclear/ ; Medical Peace Work online courses and resources: http://www.medicalpeacework.org	Link with students to expand education about the consequences of nuclear war and the planetary health imperative to eradicate nuclear weapons as part of initial and continuing health professional education Urge health journals to correct their widespread failure to publish on and address nuclear weapons on an ongoing basis
Build wide civil society collaboration and coalitions	The founding of the International Campaign to Abolish Nuclear Weapons (ICAN) by IPPNW—see Case Study	Expanding and deepening civil society collaboration, e.g., with Red Cross/Red Crescent movement; other scientific, humanitarian, development, faith, human rights, trade union, service, environmental, social justice, and other partners
Encourage, support, and collaborate with governments joining the Treaty on the Prohibition of Nuclear Weapons and otherwise working to stigmatize, prohibit, and eliminate nuclear weapons	IPPNW contributions to the 2013–2014 international conferences on the humanitarian impacts of nuclear weapons, the 2016 UN Working Group on nuclear disarmament, and the 2017 UN conference to negotiate the nuclear weapons ban treaty	Join with the Red Cross and Red Crescent movement (Council of Delegates, 2017), IPPNW, ICN, WMA, WFPHA, and others in calling on all states to promptly sign, ratify, or accede to, and faithfully implement the Treaty on the Prohibition of Nuclear Weapons

Table 21.1

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Table 21.1 Continued

Encourage divestment of public and private institutions from companies which produce nuclear weapons	Public health evidence and advocacy for divestment from landmines and cluster munitions producers, tobacco, and fossil fuels	Use positive examples, such as those outlined by Don't Bank on The Bomb (Snyder, 2022), Quit Nukes (Australia) and Don't Bank on the Bomb Scotland to promote government funds, banks, pension funds, and other private financial institutions to divest from companies producing nuclear weapons
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ICN—International Council of Nurses

IPPNW—International Physicians for the Prevention of Nuclear War

Red Cross and Red Crescent movement comprises the International Committee of the Red Cross, International Federation of Red Cross Red Crescent Societies, and 190 Red Cross Red Crescent National Societies

WMA—World Medical Association

WFPHA—World Federation of Public Health Associations

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