

Prevention of War and Its Environmental Consequences

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Abstract War leads to disastrous effects on people and the physical, biological, economic, and social environment. Environmental effects include (a) direct contamination of air, land, and water; (b) disruption of the infrastructure of society, which, in turn, leads to further environmental damage; (c) use of nonrenewable sources of energy; and (d) diversion of resources that might otherwise be used for promoting health and protecting the environment. Much can be done to minimize the environmental consequences of war and to help prevent war. Public-health-based approaches include (a) surveillance and documentation of the adverse impacts of war on the environment; (b) education and awareness-raising, and (c) design, advocacy for, and implementation of policies and programs to protect the environment, to control weapons that can harm the environment, and to help prevent war.

Keywords Environmental health, Prevention, Public Health, War

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Abbreviations

ABM	Anti-ballistic missile
BWC	Biologic and Toxic Weapons Convention
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CWC	Chemical Weapons Convention
DU	Depleted uranium
FAO	Food and Agriculture Organization
GDP	Gross domestic product
IAEA	International Atomic Energy Agency
ILO	International Labor Organization
NPT	Nuclear Nonproliferation Treaty
OPCW	Organization for the Prohibition of Chemical Weapons
PTBT	Partial Test Ban Treaty
TCE	Trichloroethylene
TNT	Trinitotoluene
UN	United Nations
UNDP	United Nations Development Program
UNHCR	Office of the United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
WHO	World Health Organization

1 War and Its Environmental Consequences

War has direct, immediate and deadly impact on human life and health. The “body counts” and the data on those with war-caused injuries and disabilities, both physical and psychological, while woefully incomplete, document the many people

tragically killed and wounded as a direct result of military activities. Through the early twentieth century, up to the start of World War II, the vast preponderance of the direct casualties of war were uniformed combatants, usually members of national armed forces. Although noncombatants suffered social, economic, and environmental consequences of war and may have been the victims of what is now termed “collateral damage” of military operations, civilians were generally not directly targeted and largely spared direct death and disability from war. But since then, the proportion of deaths to civilian noncombatants during war has substantially increased – and civilian noncombatants have increasingly been targeted during war, with tactics including abduction, rape, and ethnic cleansing.

Since at least the time of the Roman Empire, scorched earth tactics have been used in war to punish inhabitants or prevent an opponent from gaining a military advantage. These tactics specifically and directly damage the environment, affecting combatants and noncombatants alike. Civilians have, more recently, also been directly targeted by attacking armies. In 1937, Nazi forces bombed the city of Guernica in the Basque region of Spain, signaling a modern start to military operations that have increasingly killed and maimed civilians through purposeful targeting and “carpet bombing,” and through the collateral damage of heavy attacks on military targets. The percentage of civilian deaths as a proportion of all deaths directly caused by war has since increased dramatically [1]. Today, armed conflicts largely consist of the civil wars (conflicts within countries, to which other countries sometimes contribute military troops) that continue to occur in many parts of the world. During 2002, for example, 21 major armed conflicts occurred in 19 different locations. During the post Cold War period of 1990–2001, there were 57 major armed conflicts in 45 locations – all but three of which were civil wars [2].

Since the 9/11 terrorist attacks on the World Trade Center and the Pentagon, there has been increasing concern in the United States and other countries about “terrorism,” which has been defined as “politically motivated violence or the threat of violence, especially against civilians, with the intent to instill fear.” The response of the U.S. Government to these attacks has included a preemptive war in Iraq, which has resulted in a huge number of deaths and other adverse consequences; violation of human rights, including torture and other forms of cruel punishment of detainees; restriction of civil liberties; and an overemphasis on bioterrorism preparedness, with a resultant distortion of public health priorities. We believe that the Iraq War needs to end; that human rights and civil liberties need to be restored and protected; and that there needs to be a balanced approach to strengthening systems and protecting people in response to the threat of terrorism, which strengthens a broad range of public health capacities and preserves civil liberties [3].

War and other military activities also cause serious health consequences through their impact on the physical, biological, economic, and social environments in which people live. The environmental damage affects people – not only in nations directly engaged in war, but in other – and sometimes all – nations. Much of the morbidity and mortality during war, especially among civilians, has been the result of damage to or disruption of societal infrastructure, including medical-care facilities and public health services, systems to provide safe food and water supply,

sewage disposal systems, power plants and electrical grids, and transportation and communication systems. Destruction of infrastructure has led to food shortages and resultant malnutrition, contamination of food and of drinking water and resultant foodborne and waterborne illness, and medical-care and public-health deficiencies and resultant disease.

Preparation for war also can adversely affect human health. Some of the impacts are direct, such as injuries and deaths during training exercises; others are indirect. As with war itself, preparation for war can divert human, financial, and other resources that otherwise might be used for health and human services.

Damage to the physical environment – water, land, air, and outer space – and use of nonrenewable resources may result from war or preparation for war. Lakes, rivers, streams and aquifers, land masses, and the atmosphere may be polluted through testing and use of weaponry. Outer space may be damaged through placement of weapons. Nonrenewable resources may be used in weapons production, testing, and use.

A nation's economy may be adversely affected through diversion of resources to military activities from education, housing, nutrition and other human and health services and through an increase in national debt and/or taxation. These economic impacts affect both developed and developing countries.

Governmental and societal preoccupation with preparation for wars – often known as “militarism” – may lead to massive diversion and subversion of efforts to promote human welfare. This preoccupation and this diversion may be part of policies that lead to preemptive war (when an attack is allegedly imminent) and to preventive war (when an attack may be feared sometime in the future). Diversion of resources is a problem worldwide, but is especially acute in developing countries. Many developing countries spend substantially more on military expenditures than on health-related expenditures; for example, in 1990, Ethiopia spent \$16 per capita for military expenditures and only \$1 per capita for health, and Sudan spent \$25 per capita for military expenditures and only \$1 per capita for health.

The social environment may be affected by increasing militarism, by encouragement of violence as a means of settling disputes, and by infringement on civil rights and civil liberties. In addition, preparation for war, like war itself, can promote violence as a means for settling disputes. It is not surprising, in this context, that the United States has, by far, the highest rate of gun-related deaths in the world, with about 30,000 dying each year [4].

Another indirect impact of war is the creation of many refugees and internally displaced persons, whose basic human needs may not be met. A substantial number of the 12 million refugees and 22–25 million internally displaced persons worldwide have been uprooted from their homes due to war or the threat of war.

The biological environment may be disrupted in many ways as a result of weapons technologies. Nuclear weapons production, testing, use, and disposal may release ionizing radiation; shells hardened with depleted uranium also release ionizing radiation. Conventional and chemical weapons may release toxic substances

during production, testing, use, and disposal. Infectious diseases have been rarely caused by the production, testing, and use of biological weapons; much more commonly during war, infectious diseases occur due to inadequate medical care and public health services, lack of safe food or water, unsafe sewage disposal, forced migration, and crowded living circumstances.

2 Specific Aspects of War and Its Environmental Consequences

2.1 Nuclear Weapons

Nuclear weapons pose a unique threat to humans and the environment, and an assessment of the potential human health and environmental impacts of such weapons can serve as a good example of the type of assessment necessary to understand the effects of any weapon system or military endeavor.

Nuclear weapons have been increasingly widespread since their development in the 1940s. There are approximately 20,000 nuclear warheads in at least eight nations – the United States, Russia, the United Kingdom, France, China, Israel, India, and Pakistan – and possibly also North Korea [5]. The historic high in explosive capacity of the world nuclear weapons stockpiles was reached in 1960 with an explosive capacity equivalent to 20,000 megatons [20 billion tons or 40 trillion pounds] of TNT, equivalent to that of 1.4 million of the nuclear bombs dropped on Hiroshima [5]. In the United States in 1967, the nuclear stockpile had reached approximately 32,000 nuclear warheads of 30 different types. In 2003, the U.S. stockpile was about 10,400 warheads, totaling about 2,000 megatons – equivalent to 140,000 Hiroshima-size bombs. Several thousand of the nuclear weapons in the United States, Russia, and possibly other countries are on “hair-trigger” alert, ready to fire on a few minutes’ notice.

The detonation of nuclear bombs over Hiroshima and Nagasaki in August 1945 during World War II led to the immediate deaths of approximately 200,000 people, primarily civilians, as well as lasting injury and later death of many others and massive devastation – and widespread radioactive contamination – of the environment in these two cities [5]. In addition to the potential for the use of nuclear weapons by national armed forces, such as that described in the recent U.S. Nuclear Posture Review, which threatened use of nuclear weapons under a wider range of circumstances, there is an increasing threat of their use by individuals and groups [6].

Most studies and reviews of nuclear weapons and their effects have focused almost exclusively on what would happen if they were used. Notably, though, this represents only one phase in the life cycle of nuclear weapons, which includes: uranium mining, milling, conversion, and enrichment; plutonium production and separation; nuclear fuel transport; other raw material production; and weapon assembly, transport, storage, testing, maintenance and refurbishment, use, and disassembly and disposal, including recycling or disposal of all component parts [7].

Nuclear weapons present hazards in virtually all areas of their life cycle. Production and testing have their own impacts. The U.S. National Cancer Institute estimated that the release of iodine-131 in fallout from U.S. nuclear test explosions was by itself responsible for 49,000 excess cases of thyroid cancer among the U.S. population [8]. A 1991 publication by the International Physicians for the Prevention of Nuclear War estimated that the strontium-90, cesium-137, carbon-14, and polonium-239 released worldwide in all nuclear test explosions would be responsible for 430,000 cancer deaths by 2000 [9]. Additional widespread health and environmental effects of nuclear-weapons production include massive contamination of land by radioactive materials and toxic chemicals.

Epidemiological studies in the past 9 years have demonstrated serious health effects as a result of nuclear weapons testing and manufacture [10–19]. A reevaluation of the relationship between fallout from atmospheric tests conducted in Nevada found a risk ratio for thyroid neoplasms of 7.5 in the highest radiation dose group, and an excess risk ratio for thyroiditis of 4.9 per Gy of radiation exposure [10]. In addition, there were increased mortality and morbidity of United Kingdom and New Zealand military personnel involved in nuclear tests in the 1950s and 1960s. Thirty percent of nuclear veterans from the United Kingdom, New Zealand, and Fuji, who were present for atmospheric nuclear tests in the 1950s and 1960s had died by 1997, mostly in their 50s [11]. Radioactive material releases from the Mayak nuclear weapons facility in Russia contaminated the region surrounding the Techa River and led to an additional risk of leukemias (excluding chronic lymphocytic leukemia [CLL]) that was 4.6 times the background risk per Gy of radiation exposure [12].

A small study of female nuclear weapons workers in the United States found a significantly elevated odds ratio (2.09) of death from dementia associated with total lifetime radiation dose [13]. Other studies have shown an increased risk of developing leukemia (excluding CLL) associated with low doses of ionizing radiation, such as those received by nuclear weapons workers [14–17]. Noncancer effects of plutonium exposure have also been found, with a significantly greater incidence of pulmonary fibrosis among plutonium-exposed workers compared to unexposed workers. Lung doses of 10 Sv or greater of radiation conferred a 5.3-fold risk of having an abnormal chest X-ray consistent with pulmonary fibrosis [18].

One study of the molecular genetic effects of densely ionizing radiation found that, in contrast to chemical mutagens, X-rays, or endogenous aging processes, alpha particles and neutrons produce much more intrachromosomal rearrangements and deletions, and that these changes tend to be passed to successive cellular generations. More than half of blood cells of healthy former plutonium workers were found to contain large intrachromosomal rearrangements [19]. The health effects of these abnormalities are uncertain.

Impacts are not limited to human health, as the physical environment is also affected by nuclear weapons production. From 1945 to 1990, the United States produced approximately 70,000 nuclear weapons; other nations produced many additional nuclear weapons. Production of nuclear weapons has led to major environmental contamination. For example, the area around Chelyabinsk in Russia has been heavily contaminated with radioactive materials from the nuclear-weapons production facility in that area. The level of ambient radiation in and near the Techa

River has been documented as high as 28 times the normal background radiation level. Leakage of radioactive materials from storage of wastes from nuclear-weapons production at Hanford, Washington, along the Columbia River, has led to extensive radioactive contamination [20]. Open-air testing of nuclear weapons by the United States, the Soviet Union, and other countries in the 1950s and early 1960s resulted in environmental contamination, with increased rates of leukemia and other cancers among populations who were downwind from these tests [9, 10].

Disassembly and disposal of nuclear weapons has also led to environmental contamination. The primary site for the disassembly of U.S. nuclear weapons is the Pantex Plant, located 17 miles northeast of Amarillo in the Texas panhandle. The United States has dismantled about 60,000 nuclear warheads since the 1940s. More than 12,000 plutonium pits (hollow shells of plutonium encased in steel or other metal that are essential components of nuclear weapons) are stored in containers at Pantex. Plutonium, an element first produced in Manhattan Project reactors in 1942, has a half-life of 24,000 years.

These studies do not even minimally address the remaining life-cycle aspects of nuclear weapons, including raw materials acquisition, transport in the supply chain, and storage. These aspects probably account for additional environmental and human-health impacts that are not fully quantified.

2.2 Conventional Weapons

Conventional weapons consist of explosives, incendiaries, and weapons of various sizes, ranging from small arms and light weapons to heavy artillery and bombs. These weapons, the most widely used in conflicts, have accounted for the overwhelming majority of adverse environmental consequences due to war. During World War II, for example, extensive carpet bombing of cities in Europe and Japan accounted not only for many deaths and injuries, but also widespread devastation of urban environments. As another example, the more than 600 oil fires in Kuwait during the Persian Gulf War accounted for widespread environmental devastation as well as acute, and possibly chronic, respiratory ailments among people who were exposed to the smoke from these fires. As a further example, bombing of mangrove forests during the Vietnam War led to destruction of these forests, and the resultant bomb craters remain several decades afterward, often filling with stagnant water that is a breeding ground for mosquitoes that transmit malaria and other diseases.

2.3 Radiologic Weapons

“Dirty bombs,” consisting of conventional explosive devices mixed with radioactive materials, or attacks on nuclear power plants with explosive weapons could widely scatter highly radioactive materials. Another example of a radioactive weapon is shells hardened with depleted uranium (DU), uranium from which

uranium-235, the uranium isotope usable for nuclear weapons or as fuel rods for nuclear power plants, has been removed [21]. An extremely dense toxic and radioactive material, DU used as a casing increases the ability of the shell to penetrate the armor of tanks; DU is also pyrophoric and bursts into flame on impact. DU-encased shells were used by the United States during the Persian Gulf War and the Iraq War, and the war in Kosovo; similar shells were used by the United Kingdom in the Iraq War. DU can cause contamination of the soil and groundwater. DU presents less of a radioactive threat outside of the body than naturally occurring uranium. A review in 2001 concluded “that at any conceivable level of uptake depleted uranium will have no appreciable radiological or chemical carcinogenic potential” and that “the only chemical toxic effect expected would be reversible damage to the kidney”[22]. Others, however, have pointed to the inhalation of gaseous DU and the lodging of particles in the lungs and other tissues as unique hazards related to DU weapons that have been inadequately studied. Use of DU is considered legal by the nations using it, but its use is considered by others to be illegal under some international treaties [23].

2.4 Chemicals

A variety of chemical weapons and related materials have the potential for contaminating the environment during war and the preparation for war. The potential for exposure exists not only for military and civilian populations who may be exposed during the use of chemical weapons in wartime, but also for workers involved in the development, production, transport, and storage of these weapons and community residents living near facilities where these weapons are developed, produced, transported, and stored. In addition, disposal of these weapons, including their disassembly and incineration can be hazardous.

During the Vietnam War, the United States military used defoliants on mangrove forests and other vegetation, which not only defoliated and killed trees and other plants, but may also have led to excessive numbers of birth defects and cases of cancer among nearby residents in Vietnam [24]. In addition, development and production of conventional weapons involve the use of many chemicals that are toxic and can contaminate the environment. Furthermore, there is now a plausible threat of nonstate agents using chemical weapons. A Japanese cult, Aum Shinrikyo, used sarin in the subway system of two Japanese cities in the mid-1990s, accounting for the death of 19 people and injuries to thousands [25]. More recently, the toxin ricin was found in a hotel room in Las Vegas, and an individual was arrested for possessing the substance. While investigators do not believe he was planning to release the toxin, the case demonstrates the relative ease with which such chemicals can be obtained and potentially used as weapons [26].

The Chemical Weapons Convention (CWC), which entered into effect in 1997, prohibits all development, production, acquisition, stockpiling, transfer, and use of chemical weapons. It requires each state party to destroy its chemical weapons and chemical weapons production facilities, and any chemical weapons it may have

abandoned on the territory of another state party. The verification provisions of the CWC affect not only the military sector but also the civilian chemical industry worldwide through certain restrictions and obligations regarding the production, processing, and consumption of chemicals that are considered relevant to the objectives of the convention [27]. These provisions are to be verified through a combination of reporting requirements, routine onsite inspection of declared sites, and short-notice challenge inspections. The Organization for the Prohibition of Chemical Weapons (OPCW) in The Hague, established by the CWC, ensures the implementation of the provisions of the CWC. The disposal of chemical weapons required by the CWC has raised controversy about the safety of two different methods of disposal: incineration and chemical neutralization. The controversy about safety and protection of the environment has delayed completion of the disposal by the date required by the CWC [28].

2.5 Biological Agents

Biological agents are bacteria, viruses, other microorganisms, and their toxins that not only produce human illness but can also lead to long-term contamination of the environment – not only affecting humans, but potentially also other animals and plants. Biological agents have been used, although infrequently, during wars over many centuries. For example, in the sixth century BCE, Greece, Rome, and Persia used diseased corpses to attempt to contaminate sources of drinking water. In 1346, Mongols besieging the Crimean seaport Kaffa, placed cadavers of plague victims on hurling machines and threw them into the city. During the French and Indian War between 1754 and 1767, the British commander Sir Jeffrey Amherst sent blankets infected with smallpox to Native Americans. During World War I, Germany dropped bombs that contained plague bacteria over British positions and used cholera bacteria as a biological weapon in Italy. Gruinard Island, off the coast of Scotland, was contaminated by a test use of anthrax spores by the United Kingdom and the United States [29]. During the 1950s and 1960s, secret large-scale open-air tests at the U.S. Army Dugway Proving Ground may have introduced the microorganisms that cause Q fever and Venezuelan equine encephalitis into the deserts of western Utah [30]. In 1979, the accidental release of anthrax spores near Sverdlovsk in the Soviet Union resulted in at least 77 cases of inhalation anthrax and at least 66 deaths [31].

2.6 Antipersonnel Landmines

There are now approximately 80 million landmines still deployed worldwide in approximately 78 countries. These landmines have been termed “weapons of mass destruction, one person at a time.” They have often been placed in rural areas, posing a threat to residents of these areas and often disrupting farming and other activities.

Civilians are the most likely to be injured or killed by landmines, which continue to injure and kill 15,000–20,000 people annually. Since the entry into force of the Anti Personnel Landmine Convention (Mine Ban Treaty) in 1997, production of landmines has been markedly reduced and many of those that had been implanted have been removed [32]. Many additional resources will be required to continue unearthing and destroying landmines, tasks that pose inherent risks to demining personnel.

2.7 Hazardous Wastes

Hazardous wastes from military operations represent potential contaminants of air, water, and soil. For example, groundwater was contaminated with trichloroethylene (TCE), a probable human carcinogen, and other toxins at the Otis Air Force Base in Massachusetts; 125 chemicals were dumped over 30 years at the Rocky Mountain Arsenal in Colorado; and benzene, a definite human carcinogen, was found in extremely high concentrations at the McChord Air Force Base in the State of Washington [20].

2.8 Use of Nonrenewable Fuels and Other Materials by the Military

Both during war and the preparation for war, the military of many nations consumes huge amounts of fossil fuels and other nonrenewable materials. Energy consumption by military equipment can be substantial. For example, an armored division of 348 battle tanks operating for one day consumes more than 2.2 million l of fuel, and a carrier battle group operating for one day consumes more than 1.5 million l of fuel. In the late 1980s, the United States military annually consumed 18.6 million tons of fuel (more than 44 percent of the world's total), and emitted 381,000 tons of carbon monoxide, 157,000 tons of oxides of nitrogen, 78,000 tons of hydrocarbons, and 17,900 tons of sulfur dioxide [20].

2.9 Forced Migration

As armed conflict forces people to leave from their homes, a need arises for temporary shelter. Camps for internally displaced persons and refugees can have significant environmental impacts on agricultural land, forests, and other ecosystems. Refugees and internally displaced persons also require safe water and food, sanitation systems, medical-care and public health services, all of which could have direct or indirect environmental consequences [33].

3 Public Health Approaches to Prevention of War and Its Environmental Consequences

Those concerned with the promotion and protection of health classify preventive measures into three basic categories: primordial prevention, primary prevention, and secondary prevention. Primordial prevention consists of measures to prevent illness or injury by removing the conditions that lead to them. Primary prevention consists of measures to prevent the health consequences of a specific illness or injury in a specific individual or group. Secondary prevention consists of measures to prevent, or minimize the health consequences, of illness or injury (such as preventing the spread of an infectious disease to others) after the disease or injury has begun.

Prevention of scurvy (vitamin C deficiency) provides examples. Assurance that a population has access to and information about an adequate diet that includes vitamin C is an example of primordial prevention. Provision of vitamin C-containing foods to ensure an adequate intake of vitamin C among a group that does not have access to vitamin C is an example of primary prevention. To use prevention of smallpox as another example, elimination of smallpox virus is primordial prevention and vaccination against smallpox is primary prevention. Vaccination may also be used after exposure to smallpox virus has occurred to prevent the disease and its spread to others, an example of secondary prevention.

In general, primordial prevention requires political and social will. Primary prevention may be difficult to accomplish because the causes of the disease or injury may be unknown and, when they are known, the preventive methods may be difficult to implement technically or politically. Since measures for primordial or primary prevention are usually more effective and rarely have negative consequences, they are generally considered preferable to secondary prevention even when implementation is difficult or expensive. Secondary prevention is usually easier to implement politically and technically, but, since such methods are often ineffective or only partially effective, they may create a false sense of security and encourage risk-taking, can be more expensive than primary prevention, and are more likely than primordial or primary prevention methods to have adverse consequences.

Prevention of the environmental consequences of war through removal of the causes of war is an example of primordial prevention. Prevention of environmental consequences through prevention of specific wars or of use of specific weapons systems is primary prevention. Secondary prevention requires prevention of specific environmental consequences of specific weapons or specific military operations.

The environmental problems created by war and the preparation for war can appear to be overwhelming. However, standard public-health principles and implementation measures can be successfully applied in addressing these problems. This section highlights these public-health approaches.

3.1 Surveillance and Documentation

Much can be accomplished by undertaking surveillance and other activities to document these environmental problems. Surveillance can consist of both technical and nontechnical reports that help to identify potential environmental problems. Technical approaches to surveillance can include environmental monitoring as well as biological monitoring, the latter to document and assess the human burden of environmental contaminants and their adverse health consequences. Nontechnical approaches can include information from physician reports, reports in the mass media, and assessments by government agencies.

3.2 Education and Awareness-Raising

Much can also be accomplished by educating and raising the awareness of health professionals, policy-makers, and the general public about these environmental problems. A multifaceted approach that incorporates publications by citizens' groups and professional organizations, communications by the mass media, and personal communication is often valuable. In addition, efforts should be made to assist people in distinguishing between accurate and inaccurate information and in setting priorities.

3.3 Advocacy for Sound Policies and Programs

Finally, much can also be accomplished by advocating for improved policies and programs to minimize the impact of war on the environment and to help prevent war itself.

3.4 Primordial Prevention

The underlying causes of armed conflict and militarism include poverty, social inequities, adverse effects of globalization, and shame and humiliation. Some of the underlying causes of war are becoming more prevalent or worsening.

Persistence of socioeconomic disparities and other forms of social injustice are among the leading underlying causes of war. In 1960, in the 20 richest countries, the per-capita gross domestic product (GDP) was 18-fold that in the 20 poorest countries; by 1995, this gap had increased to 37-fold. Between 1980 and the late 1990s, inequality increased in 48 of 73 countries for which there are reliable data, including China, Russia, and the United States [34]. Inequality is not restricted to personal income, but other important areas of life, including health status and access to health care, education, and employment opportunities. In addition, abundant

natural resources, such as oil, minerals, metals, gemstones, drug crops, and timber, have fueled many wars in developing countries.

Globalization is similarly a two-edged sword. Insofar as globalization leads to good relations among nation-states and reductions in poverty and disparities within and among nations, it may play a powerful role in prevention of war and other forms of violence. Conversely, if globalization leads to exploitation of people, the environment, and other resources, it may lead to war and other forms of violence.

The Carnegie Commission on Preventing Deadly Conflict has identified the following factors that put nations at risk of violent conflict:

- Lack of democratic processes and unequal access to power, particularly in situations where power arises from religious or ethnic identity, and leaders are repressive or abusive of human rights.
- Social inequality characterized by markedly unequal distribution of resources and access to these resources, especially where the economy is in decline and there is, as a result, more social inequality and more competition for resources.
- Control by one group of valuable natural resources, such as oil, timber, drugs, or gems.
- Demographic changes that are so rapid that they outstrip the capability of the nation to provide basic necessary services and opportunities for employment.

Promoting Multilateralism: Since its founding in 1946, the United Nations (UN) has attempted to live up to the goal stated in its charter: “to save succeeding generations from the scourge of war.” Its mandate, along with preventing war, includes protecting human rights, promoting international justice, and helping the people of the world to achieve a sustainable standard of living. Its affiliated programs and specialized agencies include, among many others, the United Nations Children’s Fund (UNICEF), the World Health Organization (WHO), the Food and Agriculture Organization (FAO), the International Labor Organization (ILO), the United Nations Development Program (UNDP), and the Office of the UN High Commissioner for Refugees (UNHCR). These UN-related organizations, and the United Nations itself, have made an enormous difference in the lives of people over the past half-century.

The resources allocated to the UN by its member states are grossly inadequate. The annual budget for the core functions – the Secretariat operations in New York, Geneva, Nairobi, Vienna, and five Regional Commissions – is \$1.25 billion. This is about 4% of New York City’s annual budget – and nearly a billion dollars less than the yearly cost of Tokyo’s Fire Department. The entire UN system (excluding the World Bank and International Monetary Fund) spends \$12 billion a year. By comparison, annual world military expenditures – \$1 trillion – would pay for the entire UN system for more than 65 years.

The UN has no army. It relies on the voluntary contribution of troops and other personnel to halt conflicts that threaten peace and security. The United States and other Member States on the Security Council decide when and where to deploy peacekeeping troops. Long-term conflicts, such as those in the Sudan and Kashmir, and the Israeli–Palestinian conflict, fester while conflicting national priorities deadlock the UN’s ability to act. In fact, if stymied by the veto, the organization has little power beyond the bully pulpit. The United States and the United Kingdom have

severely weakened the United Nations by their unauthorized invasion of Iraq in 2003. The United States also failed to support the International War Crimes Tribunal through signature and ratification of the Statute of the International Criminal Court.

Ending Poverty and Social Injustice: Poverty and other manifestations of social injustice contribute to conditions that lead to armed conflict. Growing socioeconomic and other disparities between the rich and the poor within countries, and between rich and poor nations, also contribute to the likelihood of armed conflict. By addressing these underlying conditions through policies and programs such as the Millennium Development Goals that redistribute wealth within nations and among nations, and by providing financial and technical assistance to less-developed nations, countries like the United States can minimize poverty and other forms of social injustice that lead to armed conflict.

Creating a Culture of Peace: People in the health and environment sectors can do much to promote a culture of peace, in which nonviolent means are utilized to settle conflicts. A culture of peace is based on the values, attitudes, and behaviors that form the deep roots of peace. They are in some ways the opposite of the values, attitudes, and behaviors that reflect and inspire war and violence, but should not be equated with just the absence of war. A culture of peace can exist at the level of the family, workplace, school, and community as well as at the level of the state and in international relations. Health and environment professionals and others can play important roles in encouraging the development of a culture of peace at all these levels.

The Hague Appeal for Peace Civil Society Conference was held in 1999 on the 100th anniversary of the 1899 Hague Peace Conference. The 1899 conference, attended by governmental representatives, was devoted to finding methods for making war more humane. The 1999 conference, attended by 1,000 individuals and representatives of civil-society organizations, was devoted to finding methods to prevent war and to establish a “culture of peace.” The document adopted at the 1999 conference, the *Hague Appeal for Peace and Justice for the 21st Century*, has been translated by the United Nations into all its official languages and distributed widely around the world. Its 10-point action agenda addressed education for peace, human rights, and democracy; the adverse effects of globalization; sustainable and equitable use of environmental resources; elimination of racial, ethnic, religious, and gender intolerance; protection of children; reduction of violence; and other issues.

3.5 Primary Prevention

Primary prevention includes preventing specific elements of war and other military activities and sharply reducing preparation for war, as follows.

3.5.1 Strengthening Nuclear Weapons Treaties

Unlike the implementation of treaties banning chemical weapons and biological weapons, there is no comprehensive treaty banning the use or mandating the destruction of nuclear weapons. Instead a series of overlapping incomplete treaties

have been negotiated. The Partial Test Ban Treaty (PTBT) of 1963, promoted in part by concerns about radioactive environmental contamination, banned nuclear tests in the atmosphere, underwater, and in outer space [35]. The expansion of the PTBT, the Comprehensive Nuclear-Test-Ban Treaty (CTBT), a key step towards nuclear disarmament and preventing proliferation, was opened for signature in 1996 and has not yet entered into force. It bans nuclear explosions, for either military or civilian purposes, but does not ban computer simulations and subcritical tests, on which some nations rely to maintain the option of developing new nuclear weapons. As of April 2008, the CTBT had been signed by 178 nations and ratified by 144. Entry into force requires ratification by the 44 nuclear-capable nations, of which 35 had ratified it by April 2008. The United States has not yet ratified the CTBT [35].

The Treaty on the Nonproliferation of Nuclear Weapons (the “Non Proliferation Treaty,” or NPT) was opened for signature in 1968 and entered into force in 1970. The five nuclear-weapon states recognized under the NPT – China, France, Russia, the United Kingdom, and the United States – are parties to the treaty. The NPT attempts to prevent the spread of nuclear weapons by restricting transfer of certain technologies. It relies on a control system carried out by the International Atomic Energy Agency (IAEA), which also promotes nuclear energy. In exchange for the nonnuclear weapons states’ commitment not to develop or otherwise acquire nuclear weapons, the NPT commits the nuclear-weapon states to good-faith negotiations on nuclear disarmament. By April 2008, a total of 189 state parties (nations) had ratified the treaty. Israel, India, Pakistan, and North Korea are the only nations that are not signatories. India and Pakistan acquired nuclear weapons capability during the 1990s, while remaining outside the NPT. Israel retains a significant nuclear weapons capability, estimated at 100 weapons, also outside the NPT. North Korea has acquired a small number of nuclear weapons and Iran may be attempting to do the same [36]. Every 5 years since 1970, the states parties have held a review conference to assess implementation of the treaty. The review conference in 2000 identified and approved practical steps towards the total elimination of nuclear arsenals, which has been demanded by the International Court of Justice. The 2005 review failed as a result of political issues. Subsequently, the United States and India entered into an agreement that would permit the United States to sell fuel and nuclear technology to India. The agreement still requires approval by the U.S. Congress, India’s Parliament, the International Atomic Energy Agency, and the Nuclear Suppliers Group. Some analysts contend that the agreement would undermine the NPT by providing benefits that are currently reserved for state parties to the NPT, which India has not joined. This was widely condemned as yet another dangerous weakening of the NPT. The next NPT Review Conference is scheduled for 2010.

The Anti-Ballistic Missile (ABM) Treaty between the United States and the Soviet Union was signed and entered into force in 1972 [35]. The ABM Treaty, by limiting defensive systems that would otherwise spur an offensive arms race, has been seen as the foundation for the strategic nuclear arms reduction treaties. In 2001, President Bush announced that the United States would withdraw from the ABM Treaty within 6 months and gave formal notice, stating that it “hinders our

government's ability to develop ways to protect our people from future terrorist or rogue-state missile attacks."

The United States should help stop the spread of nuclear weapons by actively supporting and adhering to these treaties and by setting an example for the rest of the world by renouncing "first use" of nuclear weapons and development of new nuclear weapons. It should work with Russia to dismantle nuclear warheads and increase funding for programs to secure nuclear materials so they will not fall into the hands of individual and group nonstate actors.

The nations of the world should negotiate a Nuclear Weapons Convention that mandates the abolition of nuclear weapons.

3.5.2 Strengthening the Chemical Weapons Convention

The Chemical Weapons Convention (CWC) is the strongest of the arms-control treaties that outlaw a specific class of weapons. The Organization for the Prohibition of Chemical Weapons (OPCW) in The Hague is responsible for inspection and verification of compliance with the provisions of the CWC [25]. The United States has not fully supported the OPCW in its difficult tasks of inspection and in urging nations to comply with the CWC.

3.5.3 Strengthening the Biological and Toxin Weapons Convention

While the development, production, transfer, or use of biological weapons was prohibited by the 1975 Biological and Toxin Weapons Convention (BWC), several nations are believed to retain stockpiles of such weapons. The verification measures included in the BWC are weak and attempts to strengthen them have been unsuccessful. During 2002, the United States blocked attempts to strengthen the verification measures of the BWC, announcing that such measures might lead to exposure of U.S. industrial or military secrets. The United States must be urged to reverse its rejection of the international community's attempts to develop strong inspection and verification protocols for the BWC. Efforts must be made to convince all nations to support strengthening of the BWC and all nations must refrain from secret activities, often termed "defensive," that may fuel a biological arms race.

Perhaps even more important, global public health capacity to deal with all infectious disease must be strengthened. The best individual and collective efforts at diagnosing and treating disease outbreaks can be overwhelmed by any natural or intentionally induced epidemic. Consequently, support for strong global preventive public health capabilities provides the best ultimate defense against ever-evolving threats. The significant persistent global reservoirs of endemic illness in impoverished and underserved populations can provide the source of future pandemics. For example, in India during 1999 there were two million new cases of tuberculosis, causing about 450,000 deaths. An investment of \$30 million annually over a few

years, compared to the current U.S. contribution to India of \$1 million for this purpose, could virtually wipe out the disease. In addition, the United Nations has estimated that \$10 billion invested in safe water supplies could cut by up to one-third the current 4 billion cases of diarrhea worldwide that result in 2.2 million annual deaths.

3.5.4 Promoting the Antipersonnel Landmine Convention

As of November 2007, a total of 158 nations had signed or acceded to the 1997 Land Mines Convention. Of these, 156 nations had formally ratified it. Regrettably, 37 nations had neither signed nor ratified, including China, India, Iran, Israel, Russia, and the United States. Resources are desperately needed to clear the landmines currently deployed. All the nations of the world must be urged to contribute more resources to this task [32].

3.6 Secondary Prevention

Environmental consequences of war and its aftermath can also be prevented or diminished by secondary prevention – preventing environmental destruction if war occurs. Secondary prevention methods include reducing military activities, including preparation for war; negotiating effective treaties to lessen environmental damage; requiring environmental reconstruction after the war has ended; and demanding punitive reparations for environmental damage.

4 Conclusion

War and preparation for war have enormous adverse impacts on humans and their environment. Public health approaches can be utilized to address these problems, including surveillance and documentation, education and awareness-raising, and advocacy for effective policies and programs.

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