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Hippocratic Values in an Era of Nuclear Asymmetry: Should U.S. Public Health Prepare for Nuclear War with North Korea?

George A. Gellert MD, MPH, MPA

ABSTRACT

Advancements in North Korean nuclear weapons have heightened tensions and increased risk for nuclear war, and U.S. public health agencies are investing resources in nuclear attack preparation. Analyses assess the impact and value of existing protective public health strategies for limited nuclear exchange. Projections of fatality/injury from a North Korean nuclear strike and explosive impact mapping are used to assess the potential impact of an attack on major U.S. urban centers. A nuclear strike on the 20 largest U.S. urban centers would place 38.1% of Americans at risk. With 1-3 missiles of 250-kiloton yield deployed to each, 9.7 million fatalities and 16.8 million injuries would result, impacting 8.2% of the U.S. population. Extrapolation of Seoul-Tokyo nuclear attack impact data, assuming public sheltering reduces mortality 50%, indicates 4.7-9.4 million Americans could be killed. Local medical-public health personnel/infrastructure to care for survivors would be largely destroyed. Public health measures do not meaningfully decrease U.S. mortality/injury from a limited nuclear strike. Medical-public health leaders must ensure U.S. leaders comprehend the public health disaster resulting after even a limited nuclear attack, and advocate against current shifts in U.S. nuclear policy toward first use and expanded nuclear scenarios with lower use thresholds.

Keywords: Limited nuclear war, North Korea; U.S. impact limited nuclear war, nuclear strike, U.S. nuclear policy, public health personnel and nuclear strike,

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INTRODUCTION

Remarkable events in early 2018 – the intercontinental ballistic missile (ICBM) scare in Hawaii and CDC Public Health Ground Rounds on responding to nuclear detonation (planned but postponed) – appear coincidental, but are not. Sean Shields of Honolulu was arguably the first casualty of North Korea’s aggressive acceleration of the development of its nuclear capabilities, and President Trump’s past confrontational North Korea nuclear policy. On January 13, after receiving a text of the incoming missile alert, the 51-year-old said his last goodbyes via phone to his young daughter and grown son, and started to vomit. He drove himself to a family health center, where he collapsed and coded. EMTs performed CPR and transported Shields to a hospital, where myocardial infarction was confirmed and emergency care placed four stents (1). He had no cardiac history.

Other reports within one hour of the alert, which lasted 38 minutes until the State communicated the error, included paramedics responding to an elderly man who fell and a 37-year-old woman in an automobile crash (1,2). Another family reported injuries requiring medical attention for their 10-year-old child, injured when placing a mattress over a window as they desperately sought safety (1). Honolulu’s 911 emergency dispatch system was overwhelmed with calls, ED use likely increased following the false alarm, and psychological suffering during the event was likely substantial (as Shield’s partner noted, “He thought he was never going to see his kids again and this is it, we were all going to die”) (1,2). Public response to the Honolulu incident, and recent fear among many Americans, are attributable in part to mutual provocation by national leaders and their abandonment of diplomacy. A false ICBM alert is frightening at any time, but heightened public tension between the U.S. and North Korea occurred as an unnecessary, extraordinary public exchange of escalating threats between their leaders on social media substituted for diplomatic engagement, exacerbating public anxiety.

Extensive press coverage followed CDC’s announcement on January 5, days after President Trump tweeted about “big nuclear buttons” and eight days before the false missile alert, that its next Public Health Ground Rounds (broadcast online) would be dedicated to a review of response training to “prepare for nuclear detonation” (3,4). This did not help allay public fears, nor did the photograph of a nuclear mushroom cloud in CDC’s notice: 35 media outlets expressed interest in attending (5). Perception of a public health imperative to prepare physicians/health workers for nuclear attack could only further heighten public anxiety. However, the implication that there are effective ways to protect the public during nuclear attack is misleading, and an unethical misrepresentation of medical and public health facts.

Background

Increasing international tensions, augmented by bellicose communications between North Korea’s leader and the U.S. president, and the subsequent gestures of potential negotiated disarmament are contributing to growing perception of a public health imperative to prepare the U.S. population for limited nuclear attack. County and state health departments in Guam, Hawaii, California and other jurisdictions across the nation are investing resources in nuclear

attack preparation and planning, partly in response to North Korea's emergent ability to deliver nuclear warheads across the entire U.S. During the Cold War between the U.S. and U.S.S.R., near total destruction of the principal nations – Mutually Assured Destruction (MAD) – established an effective existential deterrent to a nuclear first strike. Civil preparedness of education/exercises to reduce casualties from nuclear exchange were later abandoned in the U.S.; and, before the latest escalation of tensions with North Korea, the primary nuclear public health threat to Americans was terrorist theft of low-level radioactive material used in medical diagnostics/therapy or other industries and its diffusion within a small area by conventional explosives.

Today the U.S. faces a nuclear opponent in North Korea over whom, unlike Russia, the U.S. has a large asymmetrical nuclear advantage in destructive power. Intelligence estimates of the current size of North Korea's nuclear arsenal of 15-60 low yield nuclear devices will increase to 50-100 nuclear weapons by 2020 based on rate of stockpile growth and technology advancement, as will device explosive yield to 50-100 kilotons of destructive power (6-8). In September 2017, U.S. intelligence reported a nuclear test of a more powerful thermonuclear or hydrogen bomb, which produced a 140-kiloton explosion, 10-fold more destructive than prior North Korean devices, and 10 times greater than the weapon detonated over Hiroshima (9). Intelligence community consensus suggests that 20-30 weapons could be delivered to any U.S. target today, with more deliverable several years hence (9); this excludes extensive biological and chemical weapons North Korea has in hand and ready to deploy.

Nonetheless, favorable U.S. asymmetry in overall nuclear destructive power and technology refinement relative to North Korea may be influencing the U.S. president to consider a limited nuclear exchange, in which the extent of destruction, human lives lost and casualties appear rational, and survivable. Indeed, Trump asked three times during a foreign policy briefing "If we have them [nuclear weapons], why can't we use them?", and has recommended Japan, South Korea and Saudi Arabia develop nuclear arsenals (10). Nor has he ruled out their use in Europe or against ISIS (10). The President has further stated he wishes to expand and upgrade the U.S. nuclear arsenal. U.S. nuclear doctrine is expanding to consider battlefield or tactical deployment of nuclear weapons against an opponent's military assets, beyond their historical planned retaliatory use to cause certain nuclear devastation of civilian centers. The Nuclear Posture Review by the Trump Administration, which defines U.S. nuclear weapons strategy, includes the development of two new sea-launched tactical or battlefield nuclear weapons, the first new nuclear warheads in 34 years, to be launched by submarine against an advancing army, and the resumption of nuclear testing, abandoned in 1992, at the Nevada National Security test site at a cost of \$1.2 trillion (11). An additional \$1.2 trillion is planned to support modernization of the U.S. nuclear triad of bombers, submarines and land-based missiles (11).

These changes in longstanding nuclear policy are a major departure in U.S. nuclear strategy. The Trump Administration regards expansion of U.S. nuclear capabilities as the best deterrent of aggression from other nuclear weapons-capable nations or those seeking a nuclear arsenal, and the President has authorized the identification of scenarios in which the U.S. would consider the first use of nuclear weapons in response to significant non-nuclear strategic attacks, including cyberattacks on nuclear command and control systems or civilian infrastructure such as the electricity grid (11). Prior Administrations limited the threat of a nuclear response to mass-casualty attacks from chemical, biological or nuclear weapons.

However, the underlying logic of this momentous change in the U.S. nuclear position, which substantially lowers the threshold for nuclear weapons use, is not supported by the

evidence, insofar as North Korea and Iran both engaged successful nuclear weapons development despite existing U.S. deterrence capabilities, which could destroy either nation through nuclear and/or conventional means. While most nuclear powers are building new systems and upgrading their nuclear weapons, most nuclear arms control experts across the political spectrum suggest that the Administration's actions will cause an acceleration of these efforts rather than dissuade them, as intended (11). As former Defense Secretary William Perry has noted, this new nuclear arms race will differ from the past, in that rather than involving two superpowers competing on quantity of weapons it will be defined by several nations focused on weapons quality (11).

These events and policy changes beg the question: should U.S. physicians and public health leaders prepare Americans for nuclear conflict, and in particular a second Korean War – a nuclear one – with its health consequences? And what does public health preparation for a nuclear exchange actually mean? The primary prevention message to the U.S. public during an attack is succinct: “get inside, stay inside and stay tuned” to governmental civil defense communications about if, when and how to evacuate, by routes minimizing risk of exposure to wind-borne radioactive dust particles. Sheltering in place for at least 24 hours is the most critical public message in advance of or during a nuclear attack.

However, the U.S. has no experience – and public health and medicine have little evidence – to project accurately the public health impact, acute and long-term, of detonating 50-250+ kiloton nuclear weapons over major U.S. urban centers. Each weapon would have 3-17 times the yield of the Hiroshima bomb, where 99,000-166,000 people were killed in an estimated 323,000 population (12), 69,000 were injured (13) and 60,000-90,000 structures were destroyed or severely damaged (12). Roughly half of those killed died during the first day. The U.S. Department of Energy estimated there were over 200,000 fatalities 5 years later (12) (estimating casualties was difficult because of confusion after the detonation, and raging fires consumed many bodies totally while others were vaporized instantly). Everything within a one-mile radius of the Hiroshima blast center was destroyed by a warhead with a fraction of the yield of North Korea's existing nuclear arsenal (Manhattan is 2.3 miles at its widest; the distance from Santa Monica to downtown Los Angeles is 15.7 miles). Recent analyses have shown that even a limited regional nuclear war, for example between India and Pakistan, or within Northeast Asia, would cause global climate disruption resulting in severe crop production reductions, food insecurity and a famine impacting possibly 2 billion people (14).

Methods and Results

Table 1 estimates the population at risk of death or injury if North Korea launched a nuclear strike targeting the 20 most populous U.S. Metropolitan Statistical Areas (MSAs)/urban centers. Fatalities and injuries from airburst detonation of 3 nuclear warheads of 250 kiloton yield over each MSA were estimated using NUKEMAP, a program assessing casualties from nuclear detonations in U.S. and other cities (15). A strike of this magnitude would require 60 North Korean ICBMs of moderate to high reliability and accuracy, well within the 2020 projections. To compensate for lower accuracy, and to maximize blast effects and associated mortality/injuries, air bursting/detonation of weapons above the surface would likely be utilized. In seven MSAs, one city of the usual triad was excluded from analysis due to impact map overlap with other hubs in the MSA. Across these 20 MSAs, an estimated 123.2 million Americans would be at risk, 38% of the U.S. population. An estimated 9.7 million or 3.0% of

Americans would be killed instantly, with injuries afflicting another 16.8 million (5.2%). These figures convey only the acute devastation and not the longer term, substantial health effects caused by radioactive fallout, as residual radioactive material propelled into the upper atmosphere following a nuclear blast falls back to Earth.

The U.S.-Korea Institute at Johns Hopkins estimated that a North Korean first or retaliatory strike on Seoul and Tokyo would result in 400,000-2 million fatalities and 7.7 million injuries (16). The September North Korean nuclear test had an estimated yield of 108-250 kilotons (7-16 times the Hiroshima bomb), and thus North Korea's nuclear arsenal can now be upgraded to much larger yield, possibly thermonuclear weapons (16). Detonation of 25 thermonuclear devices of varied yield (15-250 kilotons) over Seoul and Tokyo could cause 1.3-3.8 million deaths, and a single 250 kiloton warhead would afflict over three million casualties in either city (16).

Table 1. Fatalities and Injuries from Airburst Detonation of 1-3 Nuclear Warheads of 250 Kiloton Yield over the 20 Most Populous U.S. Metropolitan Statistical Areas

Largest 20 US Urban Areas/Metropolitan Statistical Areas (MSA)	Size of Population at Risk of Death/Injury (millions)	Fatalities/Injuries from 1-3 Warheads Of 250 Kiloton Yield [Calculated by NukeMap*] (millions)	
		Fatalities	Injuries
New York-Newark-Jersey City	20.1	1.4	2.4
Los Angeles-Long Beach-Anaheim	13.3	0.8	1.7
Chicago-Naperville-Elgin	9.5	0.7	0.9
Dallas-Fort Worth-Arlington	7.2	0.4	0.7
Houston-Woodlands-Sugar Land	6.8	0.5	0.9
Washington-Arlington-Alexandria	6.1	0.5	0.9
Philadelphia-Camden-Wilmington	6.1	0.3	0.8
Miami-Ft Lauderdale-W. Palm Beach	6.1	0.3	0.6
Atlanta-Sandy Springs-Roswell	5.8	0.3	0.4
Boston-Cambridge-Newton	4.8	1.0	1.0
San Francisco-Oakland-Hayward	4.7	0.7	0.9
Phoenix-Mesa-Scottsdale	4.7	0.3	0.8
Riverside-San Bernardino-Ontario	4.5	0.3	0.7
Detroit-Warren-Dearborn	4.3	0.5	0.9
Seattle-Tacoma-Bellevue	3.8	0.4	0.7
Minneapolis-St Paul-Bloomington	3.5	0.4	0.7
San Diego-Carlsbad	3.3	0.2	0.4
Tampa-St Petersburg-Clearwater	3.0	0.2	0.4
Denver-Aurora-Lakewood	2.8	0.4	0.8
St Louis MO/IL	2.8	0.1	0.2
Total Number:	123.2 million at risk	9.7 million	16.8 million
Percentage of U.S. Population:	38.1%	3.0 %	5.2%

. *Wellerstein A, NUKEMAP, <http://nuclearsecrecy.com/nukemap/>. In 7 MSAs, 1 city was excluded conservatively due to population impact overlap

Table 2 presents a linear extrapolation of the Seoul-Tokyo fatality projections to equivalent yield nuclear strikes on the 20 most populous U.S. MSAs/urban centers, an at-risk U.S. population roughly double in size (123.2 million) those two mega cities. The impact of 25 North Korean nuclear weapons of 15-250 kiloton yield, assuming low reliability and accuracy, would result in 0.8-4.0 million U.S. fatalities; more advanced warheads of a higher 250 kiloton yield could kill as many as 75.0 million Americans. These estimates omit consideration of differences between U.S. and Asian targets that could partly mitigate lethality in the U.S. Dozens of factors influence the potential impact of nuclear detonations over population centers (16). If U.S. cities have only 25-50% of the population density of Seoul or Tokyo, the number of Americans killed by 25 advanced missiles of 250 kiloton yield would fall to 18.8-37.5 million. If only 50% of warheads reach and detonate over intended targets, the fatality level could drop to 9.4-18.8 million. Assuming adequate warning time and public sheltering widely engaged, U.S. mortality could be further reduced by 50% (a generous estimate of the potential lifesaving impact of sheltering). Then 4.7-9.4 million Americans would be killed in a best-case scenario by 25 accurate missiles with 250 kiloton yields (1.4-2.9% of the U.S. population). The probability that North Korea will have soon this many ICBMs of high yield is likely far greater than all the above conditions occurring in each urban U.S. target.

Table 2. Fatalities across the 20 Most Populous U.S. Metropolitan Statistical Areas Based on Seoul-Tokyo Nuclear Impact Analyses*

Type of Nuclear Strike (Number of Warheads, Yield and Precision)	Impact Estimates on Greater Seoul-Tokyo Metropolitan Areas (62.0 million)	Impact Estimates on U.S. Population in 20 Most Populous MSAs (123.2 million)
	Fatalities (millions)	Fatalities (millions)
1 warhead, 250 kiloton yield High reliability/accuracy	1.5	3.0 (0.9% of U.S. population)
25 existing type warheads, 15-250 kiloton yield Variable reliability/accuracy	0.4-2.0	0.8-4.0 (0.2-1.2% of U.S. population)
25 warheads, 250 kiloton yield High reliability/accuracy	37.5	75.0 (23.0% of U.S. population)

*Extrapolated from Zagurek (2018) (citation 13)

Since a high yield nuclear device has never been deployed against a city, any impact projection is inherently imprecise. More certain is that much of the local medical/public health personnel and infrastructure needed to care for attack survivors in the blast vicinity will likely be destroyed. However, the impact on the U.S. will extend beyond counts of killed and injured. While financial, corporate and governmental data underpinning the international economic order, secured in the data cloud, may survive a partial nuclear attack, a substantial portion of U.S. finance, industry and trade skilled human infrastructure would be destroyed by a strike against the largest U.S. cities. This would inflict on the world a lasting financial “Global Regression” – well beyond the Great Depression or even a severe transient recession or system crash.

Discussion: Stewardship of Limited Public Health Resources

Even in a strike of limited destructive impact, what will the U.S. look like, how will it function as a modern nation, and what will livability in the U.S. be if major cities/industrial centers are even partly destroyed and uninhabitable for years? A U.S. capitol would be re-constituted elsewhere, while Washington’s historic legacy, monuments, infrastructure, and governmental and cultural institutions lie in waste. What of U.S. global tech industry leadership if the San Jose/San Francisco and Seattle areas are destroyed, as well as other industries in various targeted cities? How would American democratic and humanistic values of global importance survive the demise of Los Angeles, Chicago, Boston, Atlanta and other centers of U.S. culture, learning, science and artistic creativity?

Escalating tensions with North Korea and the continuing prospect of not achieving any meaningful nuclear arms reduction by the North Koreans make such questions today as current as they were during the Cold War. For the U.S. as a nation and for the international global order of which it is foundational, a partial nuclear strike against the U.S. remains as unthinkable today as when there was nuclear symmetry under MAD with the U.S.S.R. Contemplating the scale of impact on the U.S. population, it would be as if all the life lost, all the associated collective and individual suffering and emotional trauma, and all the disruption caused by 9/11 were a bacterium in comparison to a blue whale.

It is thus concerning that U.S. public health authorities are adapting to North Korea’s rising nuclear threat by investing already highly delimited dedicated health resources in nuclear attack preparedness planning. U.S. standing in many global health rankings is poor relative to other economically advanced nations: U.S. infant mortality stalled at 38th – among the worst in affluent nations, triple that of Japan or Norway and double Ireland, Israel or Italy. U.S. improvement in life expectancy languishes near the bottom of economically advanced nations, and is transitioning to a net decline due to the opioid epidemic; racial and income disparities in health care access and outcomes remain large. Given finite resources, one can question if there are not more pressing health imperatives demanding investment than nuclear attack preparedness to limit the unavoidable, unacceptable impact of a nuclear exchange.

While pundits decry that Kim Jong Un is irrational, thus justifying investment in civil and public health nuclear preparedness, evidence suggests he is quite rational in pursuing any means to preserve his authoritarian regime, including threatening intercontinental nuclear attack. This has been, and will remain, an effective strategy of regime self-preservation: North Korea’s policy of advancing a survivable capability of assured nuclear retaliation has been successful, and its shift from retaliatory response to threatening first use against the continental U.S. is now credible. Thus, the question begins to parallel that which existed/exists with the former

U.S.S.R./Russia – can a medical-public health response be effective and meaningful? While sheltering in place may have some value, with increasing North Korean explosive yields and advancing sophistication of its missile delivery technology, public health efforts to prevent casualties become increasingly marginal in value.

Beyond North Korea's nuclear challenge, most U.S. military and political leaders supported the agreement negotiated by the Obama Administration to halt Iranian nuclear weapons development because it verifiably achieved its objective, and included an effective surveillance/inspection capability (the International Atomic Energy Agency or IAEA of the United Nations). The alternative, a third U.S. led Mideast war is unacceptable to most Americans and leaders. Yet, while nuclear tensions escalated with North Korea, President Trump decertified and exited the U.S. from the agreement, opening a second nuclear front as the U.S. continues to resource, in military lives and expenditures, Mideast conflicts in Afghanistan and Iraq, anti-terror military operations in an expanding number of nations, and efforts to detect/counter domestic terrorist threats.

The Iranian challenge, and the prospect that Iran will again begin nuclear weapons production, could add impetus to increase resources for U.S. nuclear medical-public health preparedness, however limited their effectiveness and value. But are public health resources not better spent elsewhere? Every American should be educated to understand “get inside, stay inside and tune in”, even though doing so may not substantially lessen the overall public health and national impact of a nuclear strike. U.S. health leaders should exercise caution in pursuing nuclear attack public health preparatory measures so as not to advance the inaccurate public perception that the public health impact of a limited nuclear strike can be mitigated meaningfully, or responded to effectively from a medical perspective.

Conclusions: Hippocratic Values in an Era of Nuclear Asymmetry

Prior to eventually successful denuclearization talks between Presidents Gorbachev and Reagan, physicians and public health experts traveled globally to disseminate population projections of death and injury resulting from a U.S.-U.S.S.R. nuclear conflict. Engaging media, they met with political and military leaders to describe the impact of nuclear war on health care and public health system response capabilities – which would be eliminated or made ineffective. Today, physician advocacy organizations such as International Physicians for the Prevention of Nuclear War and Physicians for Social Responsibility have partnered with the International Coalition Against Nuclear Weapons to advance a Treaty on the Prohibition of Nuclear Weapons, which seeks the elimination of nuclear weapons and prohibits the development, testing, production, possession, stockpiling, use, or threatened use of nuclear weapons (17). Over 120 non-nuclear-weapon states have adopted the Treaty, but none of the nuclear-armed nations have done so. North Korea will not relinquish nuclear weapons as long as having nuclear capabilities buttress the current regime's grip on national power.

Our era is one of great achievement, yet beset by great failures: 90% denuclearization of Russian and U.S. war making capabilities, yet failure to stop genocides in Rwanda, Bosnia and Syria; the power of the Internet in our pockets and purses, yet also used to undermine democratic elections; deployment of rocket technology to commercialize Space and reach for Mars, yet deployed primarily to deliver unprecedented nuclear destruction. Given our Hippocratic Oath, should U.S. physicians remain silent, and thereby imply that preparatory planning will mitigate meaningfully the impact of nuclear strikes against the nation's great cities? The immediate and

long-term mortality and morbidity; the medical/public health services vacuum that blast regions would become; the sustained human suffering and transmogrification of life in the United States; and U.S. inability to contribute leadership to the world -- all argue forcefully that physicians in the U.S. and elsewhere are obliged to educate the public and national leaders about the minimal survivability of even a limited nuclear strike or exchange with an asymmetrically much weaker nuclear opponent such as North Korea, and against any false sense of security that public health preparations, education and drills might convey to the public.

Physicians once again have responsibility to help educate and ensure U.S. leaders and the public comprehend the public health crisis that will result after nuclear conflict, and to clarify that the only medically viable option is to focus on negotiation and de-escalation over the short-term, in order to enable engagement of North Korea by South Korea and the international community. Until U.S. technology enables a 100% effective ballistic missile defense, or the pre-emptive elimination of North Korean nuclear launch capabilities without precipitating a catastrophic loss of human life in Northeast Asia, the North Korean regime must be countered by compelling non-military and diplomatic means. This should include an appropriate, nuanced balance between economic sanctions and positive economic inducements that reduce North Korea's international isolation (18). There is no other medically acceptable alternative than patiently awaiting, and actively facilitating, a gradual opening of the North's population to global influences and awareness, which can drive internal erosion of autocratic control and the eventual demise of that dictatorship.

In conclusion, even limited nuclear war with North Korea remains as unthinkable today – with such an asymmetrically weaker nuclear opponent – as it was when the U.S.S.R. threatened total U.S. annihilation. Even a limited nuclear strike will render the U.S. unrecognizable and substantially unlivable from a public health viewpoint. U.S. physicians and public health leaders must engage and speak out, as they did when the atomic doomsday clock edged closer to a midnight Armageddon in the darkest years of the Cold War, and as it has once again. Strategies of limited nuclear exchange, of playing existential poker with North Korea, and of moving U.S. nuclear policy to battlefield nuclear weapons use, or first nuclear use, are unacceptable and fundamentally immoral from a public health and medical perspective. We must rise to meet Hippocrates' dictum: first do no harm. Otherwise, just as the nuclear strategist Herman Kahn queried decades ago, so too we must ask today “Will the living envy the dead?” The evidence we have suggests an unequivocal “yes”.

Declaration of Interests

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