

Nuclear weapons: catastrophic impacts on health

Transcript from Professor Andy Haines' presentation at the international Conference on the Humanitarian Impact of Nuclear Weapons.

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Video available (go to 1:03 of Day 1)

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HE Mr. Christian Guillermet, Ambassador of Costa Rica: Our next speaker is Sir Andy Haines, Professor of Public Health and Primary Care at the London School of Hygiene and Tropical Medicine (LSHTM). From 2001, until 2010, Sir Andy was Director of the LSHTM. He has been a member of a working group too of the UN intergovernmental panel on climate change. And he has also chaired a task for some health systems research for WHO. His many publications are mainly in the field of public health and primary care and include work on the implications of climate change on population health. Sir Andy will speak about the immediate consequences of nuclear weapon detonation seen from a health perspective. Sir Andy, you have the floor.

Sir Andy Haines: Well, many thanks for that introduction. It's a great honor and a privilege for me to be here today, to introduce this topic. I think, ah, clearly, we need to understand using the best available evidence, the range of impacts of nuclear weapons on population health. And what I'm going to do is to set the scene; I want to emphasize that I'm not going to be comprehensive. Many of the impacts, the longer term impacts are not going to be covered; they're going to come later on. But what I'm going to do is to very much to set the scene. And may I add my voice at the outset of those congratulating the Norwegian government for leadership on this very important topic that's been neglected for far too long. And also compliment you, Excellencies, Honored Delegates, Ladies and Gentlemen on attending this historic meeting.

So let me start then with some general statements.

Obviously, the effects of nuclear weapons depends on the size and numbers of explosions, the height of the explosions, including whether they're at ground level or not, and the distance of the subject from ground zero; that's important for the immediate effects. But as we'll hear later on, for some of the longer term effects, particularly on crop production for example, populations all around the world can be affected by nuclear weapons, even if they are at a great distance from the explosions.

There's an important distinction to be made between those nuclear explosions that occur in the air, the airbursts explosions, where the fire bursts does not touch ground. In those, fall out is really not such a major problem. But for those explosions where the fireball touches the ground, you get vaporization of dust and debris, soil, and this is carried a great distance from the initial explosion, carried by the winds, and that is what leads to radioactive fallout, with important implications for human health.

Obviously the knowledge that we have, we've already heard some of it: about Hiroshima and Nagasaki, those two instances where nuclear weapons were used. I think it's very painful for us as human beings to confront the horror of the impacts of nuclear weapons. But nevertheless, we need to do that in order to think clearly about what might be the appropriate policies to prevent this ever happening again.

There have been a number of estimates, up to 160,000 dead by a few months after the explosions in Hiroshima. The reason there have been a number of estimates is because many of the records were

destroyed and there were some doubts as to how many people were in the cities at the time of the bombings. And these of course are only the immediate effects, and near term effects of burns, radiation and other related diseases and blasts, of course. Not the longer term effects on cancer, birth defects, and so on.

There are many, many, poignant accounts of Hiroshima / Nagasaki, this is one of ones I think is particularly painful and poignant to read where the statement is:

"I look toward the Honkawa Elementary School. All of the schoolchildren, who appeared to have been at a morning assembly in the schoolyard, were burned black, squatting in orderly lines, motionless. A relief party was removing the corpses."

Nagasaki we also had massive deaths and injuries, somewhat less than Hiroshima, even though it was a larger explosion, Hiroshima was a 13 kiloton / 13,000 tons of TNT roughly, Nagasaki 22,000 tons of TNT equivalent. Somewhat less dead, still very large numbers and the reason for that, of course, the population of the two cities, and also the geography, the layout: Hiroshima is on a plateau, Nagasaki has more rolling, rolling hills, and therefore some protection of the population.

So what are the health effects? Well there are the immediate deaths from the fire ball, the center is millions of degrees Centigrade, there's this intense flash heat of radiation, and if you're exposed to that in the open air, or by window, that causes flash burns which vary in intensity, depending on how far away you are, and also the clarity of the atmosphere on the day of the explosion. There are then immediate deaths from a shock wave which travels at super sonic speed and results in falling buildings and lethal flying objects.

This picture shows you a picture of a man who is obviously trying to escape, and was caught in a firestorm which engulfed him, so he's running away and he died of burns, carbon monoxide poisoning. All the oxygen is of course sucked out of the air by the firestorm, so it's impossible to survive it. And as we shall hear later on, the firestorm also has important implications because much of the soot and debris is carried into the upper atmosphere and around the world where it has impacts on agricultural productivity.

In the near term of course, many people will be blinded by the flash, the flash burns also can cause permanent damage. And this slide shows you a retinal burn. So this will leave a permanent mark on the retina at the back of the eye, for the person exposed. In the near term of course, those who are blinded by flash blindness will be disorientated, even those who had vision will often be stumbling about, disoriented, unable to put up any kind of coherent response to the explosion.

Looking at the ranges from ground zero, at which burns would be inflicted, this slide along the top you see different sizes of bombs ranging from 1 kiloton, that's 1000 tons to 10 megatons, that's 10 million tons of TNT equivalent. And what you can see in the second line, the second degree burns which are these partial thickness burns, that they need medical care. You can see for a 100 kiloton weapon, if you're over 6km away, you can still suffer from a second degree burn which would cause severe blistering and damage to the skin.

So this would overwhelm the burn facilities of just one country. In a country like the UK for example, we might have 600 beds, something of that order for burns victims; obviously a country like Norway, many less. So these facilities would be immediately overwhelmed, even if they weren't damaged initially.

This shows you the relationship between the blast pressures, which is so called overpressure, which collapses buildings, even quite reinforced buildings can be collapsed, and the relationship on the vertical axis between the percentage of population killed or seriously injured, and the peak overpressure on the horizontal axis. And then you can see around six to eight pounds per square inch, the mortality, the death rate in the immediate term is about 50%.

So what does this mean in reality? Here I've superimposed, well, thanks to colleague Richard Moyer superimposed a 100 kiloton airburst nuclear weapon exploded over Oslo, just to give you an idea of the

dimensions of the impacts. Obviously if this would have happened, we here would be instantly killed. In that red circle, in the inner circle, which is ring number one, zone one, virtually everyone would be killed at the outset. That would extend up to about 2km from ground zero. The next zone, about 50% killed, about 45% seriously injured, a few percent relatively uninjured at the beginning. That would extend out to beyond 3km. The next zone, zone 3, about 45% of people injured, in that zone, you're still getting heavy damage, and even out to 8km, about 25% of the population in that ring would be injured in many cases by flying glass and by flying debris.

So, one bomb, over one city like Oslo effectively destroys it as a functioning entity.

I haven't yet said much about radioactivity, and as we've already heard from Patricia Lewis, initial radiation is about one-third of the total radiation, and then radioactive fallout is caused by the ground burst explosion which draws the debris into the fireball and spreads it, in a kind of cigar-shaped area down wind. Of course the larger particles fall fast, they land close, and the finer particles are carried further distances, the very fine particles being carried for intercontinental distances.

This slide shows you the fallout pattern from a one megaton surface burst / a one million ton surface burst, and I don't expect you to read all the figures, but just to give you some idea, the accumulated dose on the left there is in rads, that's an old unit, we use Grays now, but 1500 is several times the lethal dose. And that's as you can see the downwind distance of 65km or so, and the maximum width of 11km. So, one bomb, quite a large bomb, but obviously a similar magnitude from a range of smaller weapons, could affect to a lethal degree people more than 60km downwind. Of course in reality, people wouldn't know how much radiation they experienced, they wouldn't know whether they'd had a lethal amount, and in nuclear testing has shown us that there may be hot spots, the wind direction often changes. So there may be hotspots of very intense radiation and then areas of less intense radiation. But this would undoubtedly increase both the health impacts but also the psychological impacts following explosion, because people wouldn't know the degree to which they had been irradiated, those themselves, and their loved ones.

So what are the effects of radiation on the very near term? Well, the acute radiation syndrome has a number of effects: large external doses of x-rays, gamma rays and neutrons damage particularly those rapidly turning over tissues in the body, so the lining of the stomach, of the intestines, the gastrointestinal tract, the bone marrow, which produces of course the white cells that fight off infection, the platelets that enable our blood to clot, these are all damaged. The scalp, this little girl has suffered a loss of hair as a result of high radiation dosage. At very high dosage you get damage to the central nervous system, so people go unconscious very rapidly.

So in the median term, the radiation exposure would cause damage to the immune system, the white cells drop, you get decreasing resistance to infection which builds up over time, peaking around about a month, something of order, depending on the dose and so on. And deaths can occur in days, weeks or even months later.

This slide shows a young man who was about a kilometer from the ground zero. Survived the initial blast but got very ill subsequently. Shortly after this photo he died. What you can see here are the blood spots on his skin due to the loss of platelets. And this is causing hemorrhages in the skin. And sadly he died shortly after this photo was taken. So the platelet count drops to about 30 days and then people who are going to survive, it starts to come up again after that time.

We have already heard that many or most of the doctors and other health personnel in Hiroshima were killed, and that would likely be so in any attack on a major city, given that many of the hospitals are often concentrated near to the city center. Many of the schools of medicine, research centers and so on. So the health professions would be vulnerable, perhaps more vulnerable than others, to the effects of nuclear attack.

If we summarize, we can say that the health services, the burn services, blood transfusion would be immediately overwhelmed by one weapon on one city. It really wouldn't be feasible to bring in large amounts of supplies needed or health personnel. Of course the radiation exposure would mean that many

of them couldn't get in to some of the key areas to rescue people. Very important, the economic and social infrastructure would be wrecked, supply chains would be broken, so the vaccines that we depend on as a society, the pharmaceuticals, the technologies, the supply chains for all of these would be broken. And certainly in the case of a nuclear war, we would be reduced very quickly back to the Middle Ages.

In Hiroshima and Nagasaki, about 20% died of radiation sickness, 20-30% from burns, and 50-60% from other injuries compounded by a range of illnesses. And of course, a nuclear war would have disproportionately greater effects because of the destruction of infrastructure and supply chains.

So let me finish just by posing that question which was a popular one I think in the 70's and 80's, can civil defense preparations protect populations? And there was I think a trend in the 60's, 70's and 80's to say we should be making civil defense preparations against nuclear weapons. But when you think about the reality of that, it's very clear that this cannot address the sheer scale of casualties in a nuclear war.

This particular kind of primitive house-hold shelter would take many days to construct, you would have to stockpile many weeks of supplies, and even inside a shelter you would still be susceptible to the impacts of radiation depending on where you were in the fallout pattern. So civil defense depends on long-term warning, which we probably won't have, and also extensive resources to put into the preparations.

So I want to close with this statement from Joseph Garland. It was in an editorial in the New England Journal of Medicine in 1962, which accompanied a historic series of articles on the health impacts of nuclear weapons. And what he said was *"the most important function of a physician, however, relates to prevention. So very little can be done in the era in which a bomb or a series of bombs has been exploded, that the employment of every reasonable means to prevent such catastrophe becomes the concern of everyone, and not least, the physician."*

And I think that just really underscores the importance of our meeting today. Thank you very much indeed.