THE MEDICAL EFFECTS OF NUCLEAR WEAPONS

A symposium held in the Grand Committee Room, The Palace of Westminster, on 16th March, 1982.

Chairman

Sir Howard Middlemiss, CMG, MD, FRCP, FRCS, FRCR.
Professor Emeritus of Radiology, University of Bristol.

Joint Committee on the Medical Effects of Nuclear Weapons

Physical effects of nuclear weapons

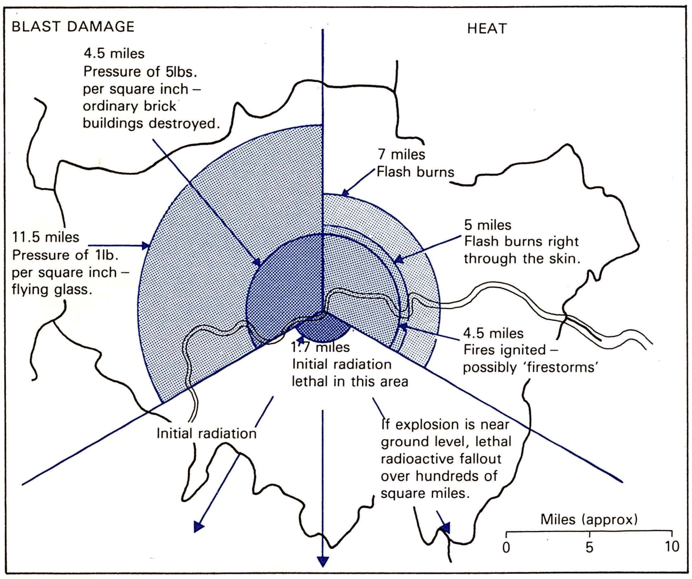
Prof. Jack Boag, DSc, F Inst Phys, FIEE, Emeritus Professor of Physics Applied to Medicine, Institute of Cancer Research, University of London.

A One Megaton Explosion

Strategic weapons range from the equivalent of a few hundred thousand tons of TNT up to 5, 10 and even 20 million tons (20 megatons). An illustration indicates the magnitude of one megaton of TNT. Old style 10-ton railway trucks were about 20 feet long. One hundred thousand such trucks would be needed to carry one megaton of TNT, and the train would be 380 miles long. It would stretch from London to Edinburgh. An equal amount of explosive power can be packed into a nuclear weapon the size of a milk churn.

What happens when a one-megaton nuclear explosion occurs over a city? The immediate effects are of four kinds:

1. An initial intense burst of nuclear radiation (neutrons and gamma rays) is emitted.
2. A 'fireball' is formed from white hot air, which grows to a diameter of more than a mile.
3. A blast wave moves outwards, destroying buildings and creating winds of several hundred miles per hour in its wake.
4. If the explosion is near ground level, huge quantities of dust and débris are sucked up into the mushroom cloud, where they become radioactive, and descend to earth gradually in a 'fallout' pattern which may extend for hundreds of miles downwind of the explosion.



A one megaton burst over Westminster.
Ordinary brick buildings would be destroyed over 60 square miles. There would be flash burns over 150 square miles.

Effects of Radiation

The injurious effects of neutron or gamma radiation are of many kinds. The first symptoms of a dose which will ultimately prove lethal are usually vomiting and diarrhoea. However, these symptoms can also result from shock, so there is no way for a doctor to know at first whether a patient has received a high dose. Death may come in hours or days, but with a slightly lower dose the victim may live for a few weeks. Young children die from less radiation than adults. Only intensive treatment involving special isolation wards, massive blood transfusions, antibiotic therapy, etc. can save a patient from a dose in the range normally lethal. None of these measures would be available in the aftermath of a nuclear attack.

A person one mile from a high one-megaton explosion who was protected from blast and heat by two feet of concrete would still receive a lethal dose of initial radiation.

If the fireball touches the ground, local fallout will occur, the area covered by fallout depending upon the wind strength and direction. It will not be possible to predict the distant parts of the fallout area, but in the area around the point of explosion there is sure to be intense radioactivity which could not only prove fatal to injured survivors but also prevent rescue personnel entering the area for days or even weeks. Following a single one-megaton explosion with half the yield due to fission, a lethal dose could be received in less than two hours over an area of about 100 square miles. If multiple explosions occurred over a limited region, the fallout patterns would overlap and the total dose rate would be greater. Fallout has many long-term effects, including the contamination of agricultural land and water supplies.

A single high-altitude explosion could destroy telecommunications equipment and shut down the electrical power network throughout the country.

Injuries from blast and heat

Mr. Jonathan Marrow, MB, BS, FRCS, Consultant in Accident and Emergency Care, Arrowe Park Hospital, Wirral, Merseyside.

Blast

Most immediate injuries from a nuclear explosion are likely to be due to blast. When buildings collapse, there will be crush injuries and fractures of limbs, ribs and spine, in many cases combined with wounds and internal injuries.

The wind generated by the blast wave will be high enough to propel through the air objects as big as cars and trucks, as well as people caught in the open, bricks, tiles and especially glass from damaged buildings. Injuries will result from the impact of flying objects or when victims picked up by the blast wind fall to earth or strike some fixed object. Even at the outskirts of areas of damage flying glass will cause injuries, including fatal penetrating wounds of the neck and chest.

In addition, high blast overpressure directly damages living tissues, especially of the lungs and ears.

Many casualties will be hurt in several ways, compounding any threat to survival and making management more complex.

Burns

Nuclear weapons differ from chemical explosives in the very large proportion of their energy that is released as heat. Flash burns are a direct result of this. The heat also causes fires, from which flame burns occur too. Fires add the further hazard of asphyxiation and poisoning from smoke.

The skin serves to retain body fluid and keep out bacteria. Burns disrupt these functions. If more than 10 or 15% of the body surface suffers even partial thickness burning, loss of fluid can be a threat to life. To some extent this loss can be made good by mouth, but after a bad burn absorption from the gut is reduced and drink is often vomited back, so that fluid has to be given intravenously.

The surface of a burn is an ideal environment for bacteria. If the area is large, infection can be overwhelming and fatal. Infection of smaller burns increases tissue damage and delays healing. To prevent this the burn is either covered with sterile dressings or the patient isolated from sources of infection.

When only superficial layers of the skin are damaged, burns usually heal quite quickly and without much scarring. Deep burns, however, can only heal painfully slowly, as skin, always abnormal and scarred, grows in from the edges. Repeated grafting and prolonged rehabilitation are often necessary to produce even imperfect functional results.

(Reprinted from: Artz, Moncrieff and Pruitt, 1979, 'Burns, A Team Approach'.)

Moderate scarring and contracture.

Even when burns are superficial, as many flash burns are, there is pronounced swelling for several days. The face and hands are the parts most commonly exposed to such injury. Swelling of the eyelids can make the patient temporarily blind, and swelling of the fingers renders the hands useless. (See photograph.)

Management of Burns and Other Injuries

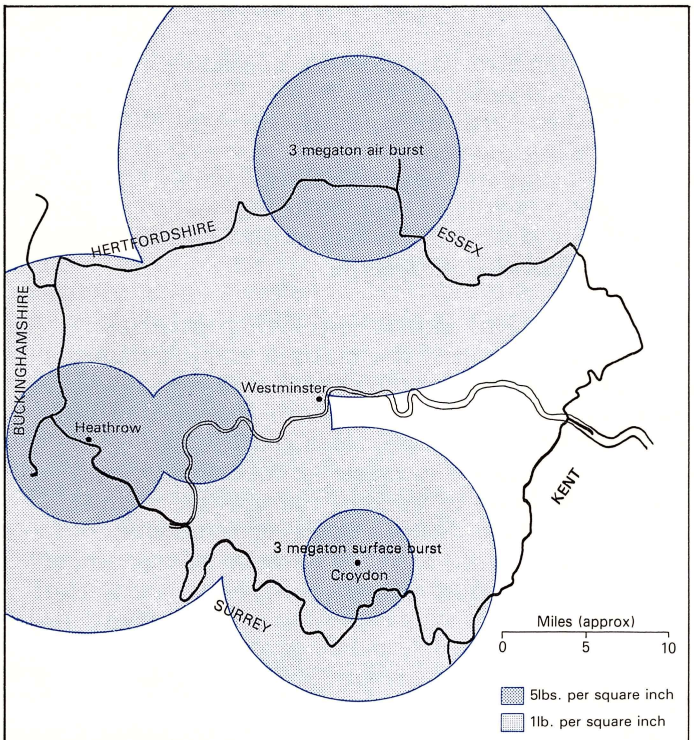
When a patient with major burns or multiple traumata is brought to hospital, attention must be diverted from the care of the less severely injured. The airway must be cleared and any blood loss made good. A careful assessment is needed to ensure no concealed injury is missed. Treatment of wounds, fractures and internal injuries may require aseptic operating conditions. Just one patient may need the exclusive attention of experienced surgeons, anaesthetist and nurses for many hours. More than two or three such patients can dislocate the routine of much of the hospital, and 20 or more demand a 'Major Accident Plan', under which all the resources of the hospital can be devoted to them.

My experience in peace-time England has included the initial reception and management of most kinds of trauma. I have seen the crush injuries which result from falling masonry. All too often I have had to deal with the injuries inflicted when the fast-moving and largely unprotected human frame strikes an unyielding object. I have seen flash burns and flame burns and the victims of chemical explosions in industry. Flying débris from a gas explosion, crush injuries when an ageing boundary wall collapses on schoolchildren, flash burns from the ignition of petrol vapour in a garage, compound fractures from a motorcycle collision, these are the types of injury that can be expected from a nuclear attack. With the important exception of the effects of ionising radiation those who treat trauma today are largely familiar with the injuries that would occur. What is outside our experience is the enormous number of people who would be injured and the extent to which facilities would be destroyed and social organisation broken down in the very areas where help would be most needed.

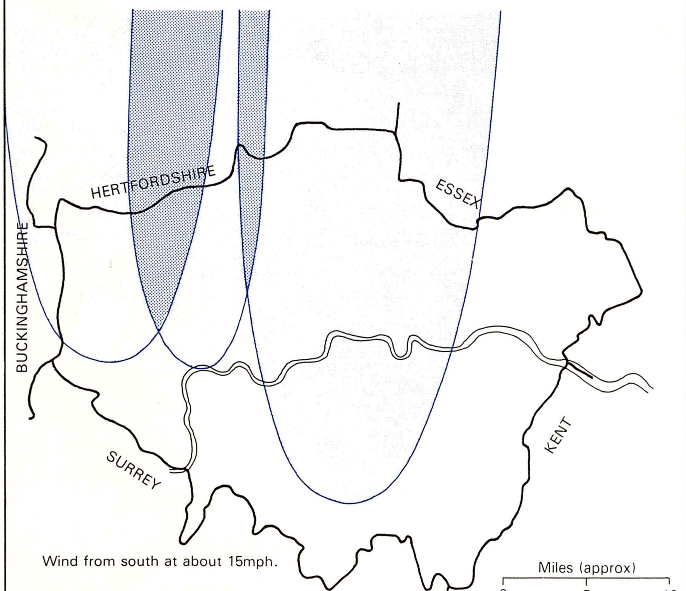
The medical consequences of a nuclear attack on London

Dr. Andrew Haines, MB, BS, MRCP, MRCGP, Consultant Epidemiologist, Northwick Park Hospital, and Senior Lecturer in General Practice, Middlesex Hospital Medical School.

Although it is not possible to be certain where missiles would land in the event of a nuclear attack, 'scenarios' may be constructed such as that of the NATO 'Square Leg' exercise, which took place in September 1980. In this exercise a nuclear attack 'took place' four days after war was declared. All 14 major roads out of London were designated prior to the attack 'Essential Service Routes' for Government traffic only. Four warheads landed within Greater London and one just outside, ranging from one to three megatons. Two landed on Heathrow and one each on Brentford, Croydon and Potters Bar. Three were ground bursts and so caused fallout. The remaining two were air bursts.



Overpressure: 5lbs. per square inch – ordinary brick buildings destroyed; 1lb. per square inch – flying glass.



Fallout: 1300 rads at two weeks, approximately twice the lethal dose.

'Square Leg' exercise – nuclear bursts on London.

In such an attack at least 1.1 million people would be killed outright by blast, and some 2.4 to 2.9 million would be injured. These numbers are based on the figures of the U.S. Office of Technology Assessment for relating overpressure to casualties and on the 1971 U.K. census. The effects of overlap of blast waves from separate explosions cannot be predicted with certainty, but would be likely to result in there being even more casualties than if there were no overlap. Many people would sustain severe burns from the flash and from secondary fires. The number of burn victims would depend upon many variables, including the number of people in the open at the time of the attack. If 25% of the population of Greater London were in the open, at least 800,000 people would suffer severe flash burns. Should people attempt to flee from the city, even more might suffer burns. Many others would be burned by secondary fires.

Assuming that doctors were injured and killed in the same proportions as the population as a whole, only some 4000 to 6000 would remain uninjured by blast and heat within Greater London. There would be some 400-900 injured patients per doctor. Even if each patient only received 20 minutes' care, it would take 7 to 17 days to see them all, by which time many would have died. In practice the situation would be worse than this. Transportation would be disrupted and many patients would not reach a doctor. Medical supplies and equipment would be totally insufficient for the massive number of casualties, and most patients could only be offered cursory medical care. In addition dense fallout would cover most of London, so that doctors and patients alike would be exposed to lethal levels of radiation. Accurate monitoring of fallout levels would not be possible. Many, even of those who had been able to follow the directions of the Home Office booklet 'Protect and Survive' and construct an 'inner refuge' in their homes, would be inadequately protected against radiation because their houses would be damaged by blast. Most of the population would be likely to die from a combination of the effects of blast, fire, initial radiation and fallout.

Those who survived the early post-attack period would then have to face a scene of utter devastation, with inadequate food, water and sanitation and in many cases weakened by radiation. In the Square Leg exercise 12 other warheads 'landed' around London and some hundred in total throughout England and Wales. Such an attack would preclude assistance from outside and impede the escape of the surviving remnants of the population. Yet this example is by no means the most destructive that could take place. About 13,000 megatons of TNT equivalent exist in the nuclear arsenals of the world. London would be devastated by less than 0.1% of this total.

General references

Glasstone, S, and Dolan, P J, US Departments of Defense and of Energy (1980) *The Effects of Nuclear Weapons*. Third edition, Tunbridge Wells, Castle House.

Muir, IFK, and Barclay, TL (1974) *Burns and Their Treatment*. Second edition, London, Lloyd-Luke.

Office of Technology Assessment, Congress of the United States (1980) *The Effects of Nuclear War*. Montclair, NJ, Allanheld Osmun.

Stockholm International Peace Research Institute (1981) *Nuclear Radiation in Warfare*. London, Taylor & Francis.

Recommended reading

The Medical Consequences of Nuclear Weapons (1982), obtainable from its producers at the addresses below, price 75 pence.

Joint Committee on the Medical Effects of Nuclear Weapons

Medical Campaign Against Nuclear Weapons
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Enquiries may be made to either of these addresses.

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