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BRITISH MEDICAL ASSOCIATION

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TO: ALL HON PRESS SECRETARIES 1 March 1983

FROM: CHIEF PRESS OFFICER

REPORT OF THE BMA'S BOARD OF SCIENCE AND EDUCATION INQUIRY INTO THE MEDICAL EFFECTS OF NUCLEAR WAR

Attached are the introduction and summaries of the report of the Board of Science and Education Inquiry into the Medical Effects of Nuclear War. The Council of the BMA is considering this on Wednesday and there will be a press conference about the report on Thursday, 3 March, at 11.00 am. This is sent to you under embargo until the time of the press conference to help in answering press queries. Copies of the full report which covers some 160 pages including appendices available to Hon Press Secretaries from this office on request.

May I draw your attention to the following paragraph in the introduction:

"The purpose of this report is to give the reader an objective and scientific account of the medical consequences that would follow the explosion of nuclear weapons. Any statement made about the use of nuclear weapons is inevitably controversial and we have been acutely conscious of our responsibility to present objective findings."

Any BMA comment should be objective and non-partisan.

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BRITISH MEDICAL ASSOCIATION

REPORT OF THE BOARD OF SCIENCE AND EDUCATION INQUIRY INTO THE MEDICAL EFFECTS OF NUCLEAR WAR

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NOT FOR PUBLICATION

THE MEDICAL EFFECTS OF NUCLEAR WEAPONS

Board of Science and Education of the British Medical Association

INTRODUCTION

The purpose of this report is to give the reader an objective and scientific account of the medical consequences that would follow the explosion of nuclear weapons. Any statement made about the use of nuclear weapons is inevitably controversial and we have been acutely conscious of our responsibility to present objective findings.

On the basis of the information and evidence presented to us we have formed our judgements about the effects of nuclear war. Each reader must make personal decisions about matters connected with the nuclear weapons debate - including, for example, whether or not a home defence programme increases the likelihood of the event it is designed to mitigate. The desirability or otherwise of stockpiling a nuclear arsenal was not part of the terms of reference of this Working Party.

We began work on our inquiry into the medical effects of nuclear war in August 1981. At the end of this study, in February 1983, our knowledge of the effects of nuclear weapons is still far from perfect, but as we have learned more so our attitudes have evolved. It is difficult to compress the findings of that 18-month journey into a few thousand words. Nevertheless, we feel that the knowledge which we have gained has allowed us to produce a report containing much information of value to doctors and others concerned with these issues. Several of the organisations and individuals who co-operated in this inquiry had not previously considered aspects of their work from the medical standpoint.

TERMS OF REFERENCE

This report arose out of work done in accordance with a resolution passed by the 1981 Annual Representative Meeting (ARM) of the British Medical Association. Each division of the BMA, representing doctors in a geographical area, sends representatives to debate issues that concern the practice of medicine and the common health at the ARM. The Annual Representative Meeting determines Association policy. In 1981 concern was expressed that members of the Association were being asked to participate in medical planning for the aftermath of a nuclear war at a time when the BMA had not formulated a policy based on a careful review of available scientific evidence.

After considering a composite motion aggregated from those submitted by several divisions, the ARM passed a resolution that:

> 'The Board of Science and Education should review the medical effects of nuclear war and the value of civil defence in order that the British Medical Association should form a policy.'

The Board of Science and Education agreed that a small working party should be set up to receive written and oral evidence from experts in many fields. The Working Party was constituted as follows:

Professor Sir John Stallworthy (Chairman)
Dr J S Horner
Mr K C McKeown
Professor J P Quilliam
Dr J D Dawson
Secretaries - Miss R Weston and subsequently Miss M Barwood

The Board of Science and Education accepted the terms of reference for the inquiry suggested by the working party. A Press statement set out the areas to be covered by the Working Party as follows:

1 The blast, thermal and immediate ionising radiation effects of nuclear weapons.

2 The clinical problems, both immediate and delayed, likely to be caused by the detonation of nuclear weapons.

3 Mortality and morbidity consequent upon varying nuclear attack patterns.

4 Immediate and long term psychiatric effects on survivors of a nuclear attack.

5 The probable effects of a nuclear attack on the work, organisation, structure and management of the health service.

6 Relations between the National Health Service and organisations involved in civil defence.

METHOD OF WORKING

We decided that the medical effects of nuclear war should be examined sufficiently widely for the report to serve as a 'stand-alone' source of reference for doctors. The press statement invited written evidence, and a call was circulated for papers relevant to the inquiry. The organisations and individuals who gave either written or oral evidence are listed in Annex 2.

Written evidence was studied carefully and a number of organisations and individualwere invited to meet the members of the Working Party to give supplementary information. Finally the Working Party drafted a report which was debated by the Board of Science and Education before being presented to the Council of the Association. (Written material was accepted for consideration up to February 1983).

STRUCTURE OF THE REPORT

SECTION 1 The report starts by describing the construction of nuclear weapons and the events that occur in the course of a nuclear explosion. Nuclear weapons have many yields, sizes and designs, and the proportion of energy given off as blast, heat and radiation differs considerably from one to another. Casualty numbers and the short and long term physical damage vary considerably according to the type of weapon and the circumstances in which it is exploded. There have been substantial increases in the accuracy of weapon delivery systems in recent years modifying strategic planning and the possible medical effects of a nuclear war.

SECTION 2 of the report deals with the numbers and types of nuclear weapons in world arsenals and with the possible form of a nuclear attack on the United Kingdom. After the precision and relative accuracy of Section 1, the picture becomes much hazier when we examine possible scenarios for an attack on the country using these weapons. An isolated nuclear explosion would allow medical aid to be brought in from unaffected areas. A major attack on multiple targets, involving the use of many weapons would preclude such aid.

SECTION 3 discusses the types of acute injuries caused by a nuclear attack and records our examination of the number of casualties that might be expected to follow an "average" attack using nuclear weapons. We discuss the massive casualty figures expected from a single nuclear explosion and the facilities available to give presently acceptable methods of treatment to blast and trauma victims. It is clear from the evidence given to the Working Party that if we were involved in a nuclear war, we should be equipped with only the experience, drug stocks and health care facilities available in peace-time. This third section also includes a detailed examination of the blast and damage figures which would result from an attack. Discrepancies between figures produced in Government publications and by other authors were identified early in our discussions.

SECTION 4 deals with the long term medical effects of nuclear explosions. The essential requirements for some considerable time after an attack would be clean water, food in a form acceptable to humans, some shelter, power and fuel supplies. Medical services in their present form would be destroyed. A health service might not be re-established for some years following a nuclear attack on this country.

SECTION 5 deals with the existing plans produced by Government for home defence. The section compares the plans that can be made for a major civilian disaster where fixed assumptions are possible, with the unknown situation following a nuclear attack. Higher levels of planning, involving sophisticated coordination and management, which were successful in the Second World War, would be likely to break down following a nuclear attack. The section discusses the problems attached to evacuation and to the provision of shelters.

SECTION 6 analyses Government's proposals for the health service in time of war and sets out our comments.

TERMINOLOGY

Radiation and Tissue Damage

When radiation enters tissue, it loses energy. Alpha and beta particles, being charged, lose energy in electrical interactions with the atomic electrons near which they pass. Gamma rays and X-rays transfer energy in a variety of ways, but each involves the liberation of electrons, which then lose energy in electrical interactions. Neutrons also transfer energy in various ways, the most important being collisions with hydrogen nuclei, which are single protons; these protons are set in motion, and being charged, again lose energy in electrical interactions. In such electrical interactions, an electron may be ejected from an atom in a molecule, thus leaving the molecule positively charged.

The passage of a charged particle through atoms may also impart energy to the atomic electrons without actually ejecting them. This process is called excitation, which is dissipated as heat in tissue.

Ionising radiations cannot be directly detected by the human senses, but they can be detected and measured by a variety of means including photographic films, geiger tubes, and scintillation counters. Measurements made with such detectors can be interpreted in terms of the radiation dose absorbed by the body or by a particular part of the body. When measurements are not possible, as, for instance, when a radionuclide is deposited in an internal organ, it is possible to calculate the dose absorbed by that organ if the activity in it is known.

Absorbed dose is expressed in a unit called the gray, symbol Gy, after a British scientist. It is a measure of the energy imparted by ionising radiation to a unit mass of matter such as tissue. A Gy corresponds to a joule per kilogram. Submultiples of the gray are frequently used such as the microgray uGy.

Relationship between old and new radiation units

Quantity	Old unit	Symbol	New unit	Symbol	Relationship
Activity	curie	Ci	becquerel	Bq	1 Ci = 3.7×10^{10} Bg
Absorbed dose	rad	rad	gray	Gy	1 rad = 0.01 Gy
Dose equivalent	rem	rem	sievert	Sv	1 rem = 0.01 Sv

Absorbed dose was formerly expressed in a unit called the rad.

Equal absorbed doses do not necessarily have equal biological effects: one Gy of alpha radiation to tissue, for instance, is more harmful than one Gy of beta radiation, because an alpha particle, being slower and more heavily charged, loses its energy much more densely along its path in tissue. To put all ionising radiations on an equal basis with regard to potential for causing harm, another quantity is needed. This is the dose equivalent. It is expressed in a unit named the sievert after a Swedish scientist, and its symbol is Sv. Dose equivalent is equal to the absorbed dose multiplied by a factor that takes account of the way a particular radiation distributes energy in tissue, thus influencing its effectiveness in causing harm. For gamma rays, X-rays, and beta particles, the factor is set at 1, and the gray and sievert are numerically equal. For alpha particles, the factor is 20, so that 1 Gy of alpha radiation corresponds to a dose equivalent of 20 Sv. Sub-multiples of the Sv are commonly used such as the millisievert, mSv.

SECTION 1

NOT FOR PUBLICATION

1-1

This section traces the history of the development of nuclear weap ıs from 1945 - when two fission weapons were exploded over Japan at Hiroshima and Nagasaki - to the present time. It includes a survey of the current range of nuclear weapons known to be in existence.

The physics and construction of nuclear weapons is described because it is impossible to appreciate the medical consequences of a nuclear war without some understanding of the processes involved.

It is also important to appreciate the changes brought about by developments in micro-electronics applied to the devices (the guidance systems) that steer nuclear weapons to their targets.

It is not enough simply to multiply the effects of the Japanese explosions in order to form a picture of the effects of a nuclear war on the United Kingdom.

Several small weapons released from a single missile cause more damage and casualties than a single warhead with equivalent yield delivered by the same missile.

Electronic communications systems are essential for effective health care. These systems can be disrupted or destroyed by the very strong electric field (EMP) resulting from high altitude nuclear explosions.

SECTION 2

NOT FOR PUBLICATION

2-1

In this Section we examine the form that a nuclear attack on the United Kingdom might take. The medical consequences of a nuclear attack would depend on many variables such as the number of explosions, air - or ground-burst, the time of day, the time of year and the targets selected. We review a number of possible patterns of attack on the United Kingdom from single explosions to a major nuclear exchange.

SECTION 3

NOT FOR PUBLICATION

3-1

MORTALITY AND MORBIDITY CONSEQUENT UPON A NUCLEAR ATTACK

Part A of this section deals with the medical effects of a nuclear explosion up to 14-21 days after an attack. Details are given of the types of injury that might be expected, and their causes.

Abstracts from the British Medical Journal are quoted in Annex 3 to illustrate standards and methods of medical care that have been applied to the treatment of victims of recent high-explosive bomb attacks in this country. These are contrasted with predictions for the number of deaths and injuries following the detonation of nuclear weapons over the United Kingdom.

Estimations for the number of casualties resulting from different types of attack are examined in Part B. There are discrepancies between the projections for blast, heat and radiation produced by the Scientific Advisory Branch of the Home Office and by the organisation Scientists Against Nuclear Arms.

SECTION 4

NOT FOR PUBLICATION

4-1

THE LONG TERM MEDICAL EFFECTS OF NUCLEAR EXPLOSIONS

Following on from the immediate medical effects of a nuclear attack, this section looks at the long-term medical effects on survivors of an 'average' attack for a period of about two years, paying special attention to the problems likely to be experience with shelter and with water, food and power supplies. Account, is taken, however, of the much longer period over which the effects of radiation might be expected to continue. The long-term medical consequences are of less immediate significance than the basic needs of survivors for water, food, shelter and power.

SECTION 5

NOT FOR PUBLICATION

5-1

HOME DEFENCE

This chapter is about civil defence or home defence - the terms which appear to us to be interchangeable. Civil defence in relation to a nuclear war would have to cover a range of organisational objectives dealing with the maintenance of a police function, the salvage of public utilities, transport and communications, in addition to questions affecting the common health of survivors. Both shelter building and evacuation policies have been expounded and criticised in the United States and we comment on designs for shelters that have been shown to the Working Party and report our discussions with a number of the experts who accepted invitations to meet members.

We have limited our inquiries to those aspects of civil defence that relate to the problems described in Sections 4 and 5. Our comments are concerned directly with the reduction of casualty numbers, and the provision of water, food, fuel, and shelter for the survivors.

SECTION 6

NOT FOR PUBLICATION

6-1

THE HEALTH SERVICE

The Government and health authorities have published plans for the National Health Service in time of war. These plans are examined alongside predictions for differing patterns of nuclear attack and projections for the resulting numbers of casualties. Serious deficiencies, which may be inevitable due to the uncertainties inherent in any nuclear attack, are highlighted.

NOT FOR PUBLICATION

SUMMARY

This section of the report gives a dispassionate summary of the medical consequences that would follow the explosion of nuclear weapons over the United Kingdom.

We repeat that we have formed our judgements about the effects of nuclear war on the basis of the information and evidence presented to us. Each reader may make personal decisions about matters connected with the nuclear weapons debate.

Nuclear war affecting the United Kingdom

The UK contains a large number of targets likely to be attacked in war and has densely populated conurbations. Potential targets and population centres are intermixed across the UK so that it is not possible to discern areas, apart from remote tracts in Scotland, and perhaps North Wales, that do not place potential targets adjacent to communities of people.

The population density of the UK is 593 people per square mile. England has a higher density of 920 people per square mile. The population density coupled with the number and distribution of potential targets is unique to the UK. No other country has so many people and so many potential targets concentrated into so small a land mass.

In the 1960s aggregation of world nuclear weapons of an explosive power of 400 Megatons was thought to ensure deterrence by Mutually Assured Destruction of both the USA and the USSR essential targets. Estimates of the total explosive power of world nuclear arsenals in 1980 varied between 25 and 50 times that quantity (400 Megatons). Any realistic assessment of the medical effects of nuclear war must take into account of changes in technology and military strategy. The effects of an attack in 1950 would have been very different from the effects of an attack now or in the future.

None of the organisations or individuals who sent papers to the Working Party, or who gave oral presentations, were able to predict with certainty where an attack on the UK with nuclear weapons would occur or in what form such an attack would be made. The unreliability of basic assumptions has been a constantly recurring problem in all areas of our investigation. Uncertainty in areas of our report is inevitable; nobody has direct experience of a nuclear attack of the magnitude envisaged in the future. However, both government and independent authorities have suggested that an attack could well be of the order of 200 megatons or greater. Furthermore, with one exception all the experts who contributed to the Working Party said that a nuclear war could not be contained, but would escalate to an unlimited, total exchange of nuclear weapons.

There are discrepancies between the projections for blast, heat and radiation produced by the Home Office and Scientists Against Nuclear Arms (SANA). The latter rely on methods and figures derived for the most part from the United States Department of Defense and the Office of Technology Assessment. We have examined the methods for calculating the projections used by SANA, and the Working Party believes, on the evidence it has received, that the projections from SANA give a more realistic estimate of the blast, heat and radiation effects of nuclear weapons. We understand that the Home Office is currently revising its calculations.

Civil Defence - Evacuation

Evacuation policies have their problems. Sufficient warning is needed in order to evacuate successfully. The economic cost to the country is tremendous and for these reasons governments would be very unwilling in practice to to put evacuation plans into effect. If, however, an attempt was made to evacuate the general population this would be seen by an enemy as part of preparations for war and might invite a pre-emptive strike.

Given the uncertainty about the pattern of an attack, that is the number and size of weapons, where they would be detonated, the period of time over which the explosions would occur, evacuation is impossible in the UK. The Government's advice to stay where you are, at home, at work or at school, effectively acknowledges this fact. There is no point upon the surface of the UK mainland that could be guaranteed immune from the effects of nuclear attacks.

Civil Defence - Shelters

The makeshift home shelters advocated by the Home Office would offer the occupants only slight protection against the blast emitted by an exploding nuclear weapon. Burns injuries caused by flying glass from shattered windows could be reduced but there would be little protection against radio-active fallout. Repeated explosions would diminish the protection against fall-out.

Advice to site the shelter at the central core of a house or building carries the risk that a substantial proportion of domestic shelters are likely to be buried when the surrounding dwelling collapses. No heavy rescue services would be available to excavate trapped survivors. If the shelter is situated near an outside wall, the occupants are more at risk from the fall-out.

In a large scale nuclear attack many areas of the country would be subjected to levels of blast damage sufficient to destroy these improvised shelters. The greater part of the country would experience blast pressures sufficient to break windows or remove doors or roof tiles from houses, which would in turn limit the protection provided against fallout. This factor is not allowed for in the current Home Office calculations.

Some of the commercially available pre-fabricated domestic nuclear shelters could offer a degree of protection against blast and heat and all would protect against fall out. None of the designs reported to the Working Party appear to have satisfactory mechanisms to eliminate dangerous combustion products of the air being drawn into the shelter. A large scale programme of public shelter building would be very costly. It could be effective in reducing short term casualties. Any survivors would face overwhelming problems in the world to which they emerged.

Long term effects of a nuclear attack

Water would be the first requirement of survivors of a nuclear attack on the country. Food, shelter, fossil fuels and electrical power would follow in that order of priority. The present water tanker capacity in the UK is wholly inadequate to supply survivors with water for even basic needs. Government plans for the supply and distribution of emergency supplies of food do not aim to provide a balanced diet. This would have serious consequences for people requiring special diets, diabetic patients, for example. There may not be a sufficient quantity of food in store to tide survivors over until alternative sources could be found.

Survivors would have to change their dietary patterns to include a much greater amount of diverse cereals and vegetables. Palatibility of food that might be available would be a major problem. Water and fuel are necessary to render many cereals edible.

There is a probability that the atmosphere would be highly perturbed by a nuclear war. The large quantities of highly sunlight-absorbing, dark particulate matter which would be produced and spread in the troposphere by the many fires would strongly restrict the penetration of sunlight to the earth's surface and would change the physical properties of the earth's atmosphere. It is likely that agricultural production in the Northern Hemisphere would be severely disrupted, so that food production for the survivors of the initial effects of the war would be very difficult.

Survival becomes even more difficult if stratospheric ozone depletions also take place. It is difficult to see how much more than a small fraction of the initial survivors of a nuclear war in the middle and high latitude regions of the Northern Hemisphere could escape famine and disease during the following years.

Other problems with implications for public health would be extensive radioactive contamination of the environment, failure of water and sewerage systems and lack of basic drugs and medical supplies.

It is inaccurate and misleading to suggest that after a nuclear attack on the United Kingdom, there would be a return to a rural civilisation of two centuries ago. The Working Party believes that there would be an increase in infant mortality, communicable diseases due to infections, and deficiency diseases caused by inadequate nutrition. The UK no longer possesses the skills or primitive technologies which allowed our predecessors an existence with some measure of comfort. The skills of the 20th Century do not permit a return to that style of life after a nuclear attack.

Effects on Medical Services

We cannot forecast what sizes of weapons might be exploded over the UK. Most current strategic and intermediate range or theatre weapons have explosive yields of between 100 kilotons and 5 megatons. The bomb dropped at Hiroshima was between 12-20 kilotons in size.

The extent of damage caused by a nuclear weapon does not increase in direct proportion to the explosive yield. Thus, to double the distance at which a given level of damage is caused requires an 8 fold increase in explosive power. It follows that if a given total weight of attack is divided into a larger number of smaller weapons, greater damage will be caused. The argument sometimes advanced that more accurate lower yield weapons will result in fewer casualties is a false one, so long as the total explosive power used in an attack remains similar.

The explosion of a single nuclear bomb of the size used at Hiroshima over a major city in the UK is likely to produce so many cases of trauma and burns requiring hospital treatment that the remaining medical services in the UK would be completely overwhelmed. An attack with, for example, 200 megatons represents an explosive power some 15,000 times greater than the Hiroshima bomb; or the equivalent of forty (40) times all the conventional explosive used in the whole of the second World War.

The NHS could not deal with the casualties that might be expected following the detonation of a single one megaton weapon over the UK. It follows that multiple nuclear explosions over several, possibly many, cities would force a breakdown in medical services across the country as a whole.

There is no possibility of increasing the production of certain drugs in a short period of tension before a war, and if we wish to have large quantities of blood products available for transfusion purposes or the bulk of the present generation of medical practitioners in the country trained for certain eventualities, then all of these things would have to be done now and the country must exist on a more or less permanent emergency footing.

We believe that such a weight of nuclear attack would cause the medical services in the country to collapse. The provision of individual medical or nursing attention for victims of a nuclear attack would become remote. At some point it would disappear completely and only the most primitive first aid services might be available from a fellow survivor.