New Zealand After Nuclear War

THE BACKGROUND PAPERS

New Zealand Planning Council
PO Box 5066, Wellington

September 1987

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BACKGROUND PAPER 10

IMPACTS ON HEALTH AND THE HEALTH CARE SYSTEM IN NEW ZEALAND

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This is one of a set of background papers prepared, in consultation with the Nuclear Impacts Study Team, from material provided by a wide range of contributors for a study of the impacts on New Zealand of a major nuclear war. Along with other sources the papers comprised the basis of the book ***New Zealand After Nuclear War****, by Wren Green, Tony Cairns and Judith Wright, published by the New Zealand Planning Council, 1987. The assumptions that the study was based on are explained in Background Paper 1, note particularly the assumption that New Zealand is not a target, and the variable assumption involving an electromagnetic pulse (EMP - for an explanation, see Background Paper 5).*

BACKGROUND INFORMATION

In order to determine the nature of the impact of a nuclear war on the operation of health services in New Zealand, the major features of the country's health care system and the present health status of the population should be understood.

Organisation of health care

Health services in New Zealand are provided by national and local government agencies, private medical practitioners, charitable and religious organisations and private citizens. However, final responsibility for, and major funding of, these services is assumed by the national government.

The central health authority is the Department of Health which has statutory responsibility for:

- investigating, preventing and limiting the spread of communicable diseases and sexually transmitted diseases;
- monitoring the manufacture, quality and safety of medicines;
- checking of water supplies, sewage disposal and air pollution and advising local authorities on the health aspects of these;
- publishing information and advice concerning public health;
- organising and controlling medical, dental and nursing services;
- administering the law on foods;

- monitoring the environment for the presence of radioactivity.

The Health Department's authority is decentralized with New Zealand being divided into 18 health districts, each with a medical officer of health resonsible for ensuring that departmental activities and policies are carried out.

The provision and maintenance of hospitals and their medical and nursing services is the responsibility of hospital or area health boards. There are 26 hospital boards and 3 area health boards in New Zealand.

Local authorities are responsible for the provision of water supply, drainage, sewage treatment, power, control of premises on which food is sold and the collection of refuse, all of which are directly linked to health status and the provision of health care in hospitals.

Features of the health care system

The New Zealand health care system, like its counterparts in other Western countries, is founded on a "medical model" of health where emphasis is given to alleviating the symptoms of illness rather than to the prevention of ill-health or health promotion. This is clearly illustrated when public sector expenditure on health care is examined. In the year 1985/86, $2.3 billion was expended on health care. Of this total, 73.13% was spent on institutional care, while public health services, which include health prevention and promotion activities, received only 3.04% of health care funding. (Health Services Research and Development Unit, unpublished data.) Medical practitioners have a chief role as the providers of health care - once registered, only they have the legal right to order diagnostic tests, prescribe medication and perform surgery. Practitioners rely upon drugs and surgery to treat illness and improve health. Hospitals are a major location for the provision of health care.

The health workforce, hospitals, and medical supplies are the central features of the health care system upon which a nuclear war is likely to have a significant effect.

Health workforce

(i) Doctors

As at 30 June 1986 there were 8,312 registered medical practitioners in New Zealand. 6,090 were active medical practitioners which constitutes a doctor to population ratio of 1:533 (Medical Council of New Zealand, 1986 Annual Report).

The medical workforce is not evenly distributed throughout New Zealand either numerically or by speciality. Rates of provision per 100,000 population vary greatly between hospital board areas as Table 1 shows.

Table 1 - **Active Medical Workforce showing rate of provision per 100,000 population in each type of employment by Board Areas in regional groupings 1986.**

	1986 Census Population	Resident Medical Officers*	General Practitioners	Specialists	Other	Total
Auckland	889,167	60.3	72.7	61.5	10.1	204.6
Canterbury	353,335	63.5	69.1	64.0	7.9	204.3
Otago	121,843	99.3	64.8	119.0	23.0	306.1
Waikato	338,524	44.7	61.7	47.9	2.7	156.9
Wellington	345,620	60.2	63.9	72.0	10.2	206.3
Hawkes Bay	127,644	29.8	58.0	45.4	2.4	135.5
Nelson	69,777	53.0	77.4	55.9	1.4	157.6
Northland	127,616	23.4	68.2	33.7	6.3	131.6
Palmerston North	133,990	53.0	51.5	58.2	5.9	168.7
South Canterbury	56,494	21.3	51.3	44.3	1.8	118.6
Southland	116,449	30.0	53.2	24.9	0.9	109.1
Taranaki	103,107	32.9	56.3	46.6	1.0	136.8
Tauranga	85,436	31.6	66.7	51.5	2.4	152.2
Wanganui	74,232	18.8	49.8	45.8	2.6	117.2
Boards 30-50,000	242,778	12.5	55.4	29.4	6.4	99.9
Boards under 30,000	121,032	10.3	46.9	14.9	3.8	69.9
TOTAL	3,307,084	47.3	64.7	55.0	10.3	173.8

*"Resident Medical Officers" include House Officers and Senior House Officers, Registrars and MOs on a special scale. "Other" includes primary care practitioners with "other" emphasis.

Source: Department of Health

There is a particularly noticeable variation in the distribution of general practitioners. For example, there are more than 70 GPs per 100,000 population in Auckland and Nelson yet there are 53 or fewer in Palmerston North, Wanganui, South Canterbury and Southland.

(ii) Nurses

Nurses are the largest single group of health workers in New Zealand. At 31 March 1985, 38,836 registered and enrolled nurses held valid annual practising certificates (New Zealand Year Book 1986-7). Table 2 shows a breakdown of the nursing workforce by type of specialised nursing care given.

Table 2 - The nursing workforce sphere of nursing by type of nurse, 31.3.80.

Sphere of Nursing	Total Nursing Workforce No.	%	Rate Per 100,000 Population
Hospitals			
General and obstetric	17,918	67.6	573
Psychiatric and psychopaedic	4,141	15.6	132
Private	1,600	6.0	51
Community nursing			
District	753	2.8	24
Occupational health	190	0.7	6
Plunket	304	1.1	10
Practice	649	2.4	21
Public health	474	1.8	15
Other			
Teaching	419	1.6	13
Miscellaneous	51	0.2	2
TOTAL	26,499	100.0	847

Source: *Health Facts New Zealand* (Department of Health, 1983)

(iii) Other health workers

The health industry is labour-intensive and doctors and nurses are supported by large numbers of other health workers. In 1980 there were 49,100 people in the health workforce, including dentists, pharmacists, optometrists, radiographers and physiotherapists (*Health Facts New Zealand*. Department of Health, 1983). In addition to these occupational groups, health practitioners such as acupuncturists, chiropractors and homeopaths are active in New Zealand. Numbers engaged in these latter activities are not known.

Hospitals

At 31 March 1985 there were 31,273 beds available in New Zealand's public and private hospitals. A breakdown of the types of beds available is shown in Tables 3 and 4:

Table 3 : Number of beds in Public Institutions, 31 March 1985

Type of Bed	Beds Available	
	Number	Proportion per 1000 of Population
General	14,221	4.3
Maternity	2,121	0.6
Psychiatric and psychopaedic	8,143	2.5
Total hospital beds	24,485	7.4
Non-hospital beds	870	0.3
TOTAL	25,355	7.7

Source: *New Zealand Year Book 1986-87*

Table 4 : Private Hospitals by type and number of beds, 31 March 1985

Type of Hospital	Licensed Beds		
	1983	1984	1985
Maternity	30	25	19
Medical and surgical	1,399	1,397	641
Medical, surgical and/or geriatric	4,124	4,269	5,119
Maternity, medical and surgical	102	102	102
Psychiatric/geriatric	45	45	37
TOTAL	5,700	5,838	5,918

Source: *New Zealand Year Book 1986-87*

Hospital boards serve vastly different population numbers, ranging from Auckland which provides health care for 890,000 people, to Maniototo which services 3,000. As a consequence of these variations, there are considerable differences in the types of services provided by individual boards which, in turn, produce a wide variation in the distribution of medical equipment and resources.

Most general hospitals provide a service covering the basic specialities of general medicine, general surgery, paediatrics, orthopaedics, obstetrics and gynaecology, ophthalmology, ear, nose and throat, psychiatry and geriatrics. In addition to these, provincial hospitals have neurological, cardiological, gastroenterological and urological specialities. At a third level are the regional specialities covering nuclear medicine, cardiac/thoracic surgery, renal transplant and dialysis, plastic surgery and burns, neurosurgery. The location of these specialities is determined by the government. Neurosurgery, for example, is available only in Auckland, Wellington and Dunedin.

The effect of the dispersion of medical specialties on patients is that they must travel, often large distances, to receive treatment.

Medical supplies

New Zealand relies heavily on imported supplies of medicines and medical devices.

(i) Medicines

Ethical pharmaceuticals are covered by the Medicines Act 1981, which defines the term "medicine" as any substance or article that is administered to human beings for therapeutic purpose - that is, for the treatment or prevention of disease, the diagnosis of disease, to effect contraception, for the inducement of anaesthesia, or for altering the shape or structure of the human body. Approximately 75% of ethical pharmaceuticals are imported fully packaged, ready for use. The balance is made locally using imported raw materials or intermediate products. The pure chemicals included in most medicines are synthesised in Northern Hemisphere laboratories and have to be imported, while excipients (filling materials) are imported because local materials are not of a sufficiently high and consistent quality for pharmaceutical purposes.

All vaccination material for human use (i.e. vaccines against polio, tuberculosis, diphtheria, tetanus, typhoid and rubella) is imported. Local and volatile anaesthetic agents are all imported. But anaesthetic gases - oxygen and nitrous oxide - are made in New Zealand. Blood products and most intravenous fluids require imported ingredients.

Oral contraceptive pills - which are widely used in New Zealand - and the injectable contraceptive, Depo Provera, are also imported. Even the medicines extracted from indigenous materials (eg heparin, an anti-coagulant produced from sheep gut mucosa by New Zealand Pharmaceuticals Ltd in Linton) are filtered and put into ampules overseas.

The pharmaceutical supply industry is concentrated in Auckland, although Wellington and Palmerston North have manufacturing facilities. A comprehensive network of wholesalers ensures New Zealand-wide distribution to retail and hospital pharmacies. Typical supply lines in the country contain 3-5 months stock in total (i.e. from raw materials through to retail stocks).

(ii) Medical Devices

A medical device is any device, instrument, apparatus or contrivance that is used on or by human beings for a therapeutic purpose. (Medicines Act 1981.) The medical devices used in New Zealand are, like medicines, almost totally imported. The United States and Western Europe are the major suppliers of medical devices. Plastic is a major component in important medical equipment - syringes, catheters, drips, drainage bags - but the raw materials to make plastic are imported.

Computers and equipment with electronic instrumentation (including organ imaging machines, monitoring equipment of various sorts, laboratory apparatus) are all imported from the Northern Hemisphere. Spare parts are also imported.

X-ray tubes and X-ray film originate from the United States of America. Approximately one month's supply of film is held in New Zealand (Chief Physicist, Canterbury Hospital Board).

Sutures, syringes, tubing for aspiration and drips, and surgical instruments are all imported. The reagents and tests used for diagnostic laboratory work depend on imported chemicals.

Condoms, diaphragms and caps are made from latex and plastic and are all imported. Some condoms are made from the appendices of New Zealand lambs but final processing is carried out overseas since rubber is needed to secure the condoms and lubricants must be added (*New Scientist*, 26/2/87).

Health status in New Zealand

An examination of hospital discharge data and mortality data provides information about the types of conditions and disorders being dealt with by medical practitioners and the health care system. Tables 5 and 6 show that the incidence of deaths and illness is largely attributable to heart disease, cancer and strokes - "lifestyle" diseases caused by excessive smoking and drinking, obesity and lack of exercise.

Infectious diseases which were the major cause of death at the turn of the century have largely been eradicated. Between 1981 and 1985 only seven cases of diphtheria, twenty-four cases of tetanus and thirty-six cases of typhoid fever were reported to the Department of Health, and no cases of polio. The infectious diseases most commonly notified were those originating from contaminated food - campylobacter (6,767 cases), salmonellosis (5,473 cases) and shigellosis (880 cases).

The Health Department conducts a national immunisation programme to protect children against the serious effects of polio, diphtheria, whooping cough, tetanus, measles and rubella. In 1985, 94% of new school entrants were fully protected (*The Public Health*, report of the Department of Health, 31 March 1986). Data is not available to indicate how many adults have never been immunised against these diseases but it can be assumed that a sizeable minority do not have protection and that the incidence of communicable diseases would increase if the vaccination programme was disrupted and if living conditions deteriorated.

Table 5 : Patients discharged from or dying in public hospitals, 1984

Disease	Mean stay (days)	Total both sexes
ALL CAUSES	10.6	429,745
Infectious and Parasitic Diseases	7.6	8,751
Neoplasms - Cancers	11.9	29,369
Endocrine, Nutritional, Immunity and Metabolic Diseases	16.3	5,734
Diseases of Blood and Blood Forming Organs	7.5	2,481
Mental Disorders	37.4	9,596
Diseases of the Nervous System and Sense Organs	15.6	18,128
Diseases of the Circulatory System	22.9	40,395
Diseases of the Respiratory System	8.1	35,194
Diseases of the Digestive System	7.2	30,213
Diseases of the Genitourinary System	5.7	27,946
Pregnancy and Complications of Childbirth and Puerperium	5.8	72,288
Diseases of the Skin and Subcutaneous Tissue	8.5	5,946
Diseases of Musculoskeletal system and Connective Tissue	13.8	17,860
Congential Anomalies	8.6	6,540
Conditions Originating in the Perinatal period	9.8	8,158
Symptoms, Signs and Ill-defined Conditions	8.1	23,189
Injury and Poisoning	10.0	56,311
Supplementary Classifications	6.0	32,646

Source: *Hospital and Selected Morbidity Data 1984* (National Health Statistics Centre, 1984)

Table 6: Selected causes of death, numbers and rates 1979 - 1984

Disease	Mean Annual Number of Deaths Registered		Mean Annual Rates per 100,000 Population	
	1979-83	1984	1979-83	1984
Tuberculosis	50	55	1.6	1.7
All other infectious and parasitic diseases	107	97	3.4	3.0
Malignant neoplasm of bronchus, lung and trachea	1,163	1,282	36.8	39.3
Other malignant neoplasms	4,453	4,606	141.0	141.4
Diabetes mellitus	392	341	12.4	10.5
Cerebrovascular disease	2,970	2,811	94.1	86.3
Active rheumatic fever and chronic rheumatic heart disease	142	123	4.5	3.8
Other forms of heart disease and hypertension	8,619	8,353	273.0	256.4
Influenza	70	22	2.2	0.7
Pneumonia	1,078	1,063	34.1	32.6
Bronchitis	394	292	12.5	9.0
Asthma	239	211	7.6	6.5
Ulcer of stomach and duodenum	155	176	4.9	5.4
Diseases of liver and gall bladder	198	176	6.3	5.4
Nephritis and nephrosis	49	39	1.6	1.2
Hyperplasia of prostate	24	16	0.8	0.5
Congenial anomalies	230	212	7.3	6.5
Motor vehicle accidents	660	710	20.9	21.8
Suicide and self-inflicted injury	335	389	10.6	11.9
Homicide	45	38	1.4	1.2
Other accidental and violent deaths	830	634	26.3	19.5
Other causes	3,548	3,737	112.4	114.7
TOTAL, all causes	25,752	25,383	815.7	779.0

Source: *The Public Health* - Report of the Department of Health, 31 March 1986.

IMPACTS OF NUCLEAR WAR ON HEALTH

Overseas studies of the effects on health following a major nuclear war focus on burns, casualties from radiation, malnutrition, stress and infectious diseases. The effects of radiation would not be the major health problem if New Zealand was

not directly targeted. Nevertheless, serious health problems would be experienced in New Zealand.

Radiation

Radiogenic cancers and thyroid disorders

Local scientists seem to believe that "in the event of a large-scale nuclear war in which some detonations occurred in the Southern Hemisphere, radioactive fallout on New Zealand would be unlikely to give rise to observable health effects and would be a rather minor consideration compared to the likely economic and social disruption that would result" (National Radiation Laboratory).

Human exposure to radiation occurs through absorption of radioactive material deposited on the ground or ingestion of contaminated foodstuffs. The amount of radioactive fallout to reach New Zealand following nuclear detonations in Australia would depend on geographical location of the explosions, prevailing weather patterns and altitudes at which the devices were exploded. However, it can be estimated that exposure to cesium-137 would induce 70 fatal non-thyroid cancers per megaton (Mt) of fission yield. That is, based on the assumptions made for the study (see Background Paper 1) there could be a total of 7,000 cancers, which would become apparent over the following seventy years, caused by the Australian detonations. (DSIR and Background Paper 10.)

If the east coast of Australia was hit by a nuclear device, short-lived radionuclides, particularly iodine-131, would be deposited on New Zealand. The fallout would reach New Zealand in two to three days and within twenty-four hours of deposition, radioactive iodine would be present in milk. If milk products contaminated by radioactive iodine were consumed, 4,000 new cases of thyroid cancer could develop over the ensuing seventy years. With current treatment methods and supplies, ten percent of these would be fatal (see Background Paper 9).

Against a background incidence of 6,000 *deaths* annually from cancer, the number of radiogenic cancers resulting from a major nuclear war is unlikely to be detectable amongst the indigenous New Zealand population. The increase in thyroid disorders may be statistically detectable if left untreated.

Effects on skin of increased ultraviolet (UV) light

The immediate effect on humans of a fifty percent increase in UV radiation would be an increased incidence of sunburn, unless adequate protective measures were taken. The long-term effect, after two or three years, would be an increase in non-melanoma skin cancer. The annual incidence as estimated by a leading dermatologist, of basal cell carcinoma, would increase from 289/100,000 to 376/100,000 and from 153/100,000 to 245/100,000 for squamous cell carcinoma. Mortality would not be signifcantly affected by the increased incidence of non-melanoma skin cancer, but there would be an increased demand for medical attention.

Infection and communicable diseases

New Zealanders would have a lowered resistance to infection, and communicable diseases would spread rapidly, following a nuclear war. Impure water, contaminated food and unsanitary conditions would cause outbreaks of infectious disease.

Poor Nutrition

Food production, processing and distribution systems would be affected by a nuclear war, particularly if there was an EMP effect. People without the ability to produce their own food could have to contend with food shortages. Although unlikely to starve (see Background Paper 4) New Zealanders could face dietary deficiencies which would lead to an increased susceptibility to infections. In severely malnourished persons, infections which usually cause minor illnesses may result in death. (*New England Journal of Medicine*, October 1986.)

Disease caused by disruption to water supplies and sewage treatment

The development this century of sanitary water supply, sewage treatment and waste disposal systems has been principally responsible for limiting the spread of communicable disease in New Zealand. An EMP would cause major disruptions to these systems and the health consequences could be severe.

Within 1-2 days of an EMP, household water supplies would run out (Background Paper 13). Unless power was restored, alternative sources of water (rivers, streams, wells) could become contaminated by overflowing sewage. Contaminated water and the lack of water for general hygiene (washing hands, food preparation, bathing) would give rise to significant increase in gastroenteritis and infections caused by the common enteric bacteria salmonella, shigella and campylobacter. Severe gastroenteritis could lead to excessive mortality amongst the frail, newborn, and elderly. Streptococci and staphylococci infections would also proliferate.

If disruptions to water supply and sewage treatment continued for a long time, there could be major outbreaks of cholera and typhoid - diseases which are transmitted by the ingestion of water contaminated by faeces or through food which has been contaminated by impure water. Shellfish and seafoods taken from sewage-contaminated waters would be a secondary source of infection.

Since insects and rodents are carriers of disease, the increase in their populations following a depletion of insecticide stocks and the build-up of waste materials would contribute to the spread of disease.

A major influx of migrants or refugees, particularly from Asia and the Pacific, could dramatically increase the spread of communicable disease. If migrant camps were established, overcrowding might occur, which, in addition to poor nutrition and poor hygiene, could cause tuberculosis and respiratory diseases such as viral pneumonia and influenza to spread rapidly.

In the longer term the continued contamination of water supplies and a lack of sanitation would cause epidemics of tuberculosis, typhoid, intestinal diseases and possibly cholera. These diseases can be fatal and require treatment, particularly with antibiotics, if mortality is to be minimized.

It is extremely difficult to estimate either the incidence of, or mortality from, infection that would occur in New Zealand if infectious diseases became widespread following a nuclear war. However, Abrams, an American expert on communicable disease, has estimated that in the absence of medical intervention, 20 to 25 percent of the post-war population could die as a result of contracting a communicable disease. (*Last Aid*, p. 231.) This estimate takes into account an increased susceptibility to infection caused by exposure to higher levels of radiation than are expected in New Zealand, but it seems highly probable that a significant proportion of the New Zealand population would die following a major nuclear war.

Psychological effects

A major nuclear war would severely affect the mental health of the population (see Background Paper 12, *The Impacts on New Zealand Society*) particularly if communication links with the rest of the world and within New Zealand were severed. People would experience a range of feelings from uncertainty, anger, denial, grief at possible loss of relatives, to fear of the future. Panic and apathy are common reactions to disasters and these could cause social order to deteriorate.

Reactions to nuclear war and the stress associated with lack of food and sanitation - that is, adapting to a radically different way of living - would lower people's resistance to infection. Clinical studies indicate that psychological factors influence susceptibility to respiratory tract infections, influenza, tuberculosis and other viral diseases (*New England Journal of Medicine*, October 1986).

At times of disaster, contraception tends not to be practised consistently (Family Planning Association). Following a nuclear war this could lead to an increase in the rate of pregnancy.

Impacts on health - conclusion

Even if the country was not directly targeted, the health of the majority of people in New Zealand would be affected by a major nuclear war. The indirect effects could be as damaging as any direct effects. The health care system would be expected to deal with these impacts on health.

IMPACTS OF NUCLEAR WAR ON THE HEALTH CARE SYSTEM

Because of changes in health status following nuclear war, there would be new and considerably different demands made on the health care system.

The psychological effects of a nuclear war would be particularly devastating and health workers would be called upon to provide counselling services and crisis support. However, mental health problems might be better resolved by ensuring that people received adequate *information* about the war and its possible consequences and *advice* on how to deal with any food shortages, breakdowns of sanitation and physical health problems that might arise. In particular, there would be a need for advice and information about protection from radiation (for example, whether or not to avoid drinking milk and substitute with milk powder) and decontamination

or not to avoid drinking milk and substitute with milk powder) and decontamination procedures, in order to alleviate public fears about the consequences of radioactive fallout. Pregnant women may be particularly fearful and there could be an increased demand for abortion.

Little can be done to counteract the radiation dose from the up-take of cesium and strontium deposits but treatment with iodide reduces thyroid morbidity and iodine prophylaxis would be an important public health measure. The Department of Health's Seaview store holds 440,000 potassium iodate tablets, stockpiled for use in the event of an accident on a nuclear-powered vessel. This amount would *not* be adequate in the event of nuclear war, according to a member of the 1983 Radiological Advisory Council. If Australia were targeted, tablets could be required for distribution to the entire population of New Zealand, yet there are obviously insufficient held in stock to do this.

Refugees suffering from radiation sickness would require treatment with antibiotics, intravenous fluids and blood components. Refugees who had received high doses of radiation could need bone marrow transplants (*Last Aid*, p. 238). Treatment for them would be possible but ethical issues concerning priorities for treatment with scarce resources would be paramount. Sunblocks and sunscreens would be needed to prevent skin cancer.

The possibility of an increased incidence of infectious diseases would present the most serious implications for the health services. In particular there would be a need for antibiotics and vaccines and there would also be an urgent need for education and health promotion programmes to prevent the occurrence of infectious diseases and to limit their spread.

Whether the health care system would be able to meet these needs would be determined, in part, by the impact of nuclear war on the availability of medicines and medical supplies, on the health workforce and on hospitals.

Medicines and Medical Supplies

Given New Zealand's almost complete reliance on imports for medical devices and equipment, medicines and raw materials for the manufacture of medicines, the inability to acquire these resources following a nuclear war would have a significant impact on health.

Medicines

If the health care system was able to continue functioning in its present form (that is, if social order was maintained) supplies of most pharmaceuticals would last 3-6 months at normal rates of usage (Pharmaceutical Manufacturers Association). Controlled drugs such as opiates are held in limited supply because of restricted drug regulations and could be expected to last for 2 months only. These estimates do not allow for an increased demand for drugs due to outbreaks of infectious diseases or for panic-buying and hoarding by the public and health professionals, all of which would hasten the depletion of current stocks.

Antibiotics, morphine, codeine and aspirin could possibly be obtained from Australia, although this source could not be relied upon as Australia would presumably seek to conserve medicines for its own population.

Any shortages of medicines would have a devastating effect on health and the health care system. Epidemics of typhoid fever, diphtheria, tuberculosis and dysentery could occur, and infectious diseases could again become a major cause of death.

Effects of the loss of particular medicines are indicated below:

(i) Antibiotics

The unavailability of antibiotics would have serious consequences for several reasons. Firstly, antibiotics are essential for the treatment of infectious diseases, and without them the diseases identified as becoming prevalent following a breakdown in sanitation could not be controlled.

The lack of antibiotics in hospitals coupled with difficulties in maintaining a high standard of hygiene would greatly increase the risk of infection for people undergoing surgery "since any surgical incision results in the entry of bacteria into the wound" (*New Ethicals*, March 1984, p. 51). As a result, a considerable number of people would die post-operatively from infection, as they did in the pre-antibiotic era.

Gonoccocal and chlamydial infections (i.e. sexually transmitted diseases) would increase since antibiotics are required for effective treatment. If left untreated these infections cause considerable discomfort and may eventually result in death.

(ii) Vaccines

Immunisation of infants could continue for a few months until supplies of vaccines were exhausted. It is estimated (Department of Health) that supplies of most vaccines would be depleted after six months. In time, the classic paediatric infectious diseases of diphtheria, tetanus, whooping cough, measles, polio and tuberculosis would re-emerge with a subsequent sharp increase in the mortality of infants and young children. For diseases such as these, immunization is the only effective direct means of control.

(iii) Medicines for Chronic Conditions

Morbidity (illness) and mortality rates from non-communicable diseases such as asthma, epilepsy, diabetes and some psychological disorders would increase, as continuous medication is needed to stabilise these conditions. Insulin, for example, is imported and if supplies ceased, between 5,000 and 6,000 insulin-dependent New Zealanders would die (Physician, Wellington Hospital). Other diabetics who are insulin-deficient would have their quality of life impaired.

Treatment for patients with cancer and heart disease would be reduced as all of the essential drugs are imported. Many patients are dependent on these drugs for their survival and would therefore die, although doctors at the Cancer Research Laboratory in Auckland are currently developing treatments which could be available in the future.

(iv) Anaesthetics

Supplies of anaesthetic drugs (induction agents and muscle relaxants) would be depleted after six months (Anaesthetist, Christchurch Hospital). Locally produced gases and ether would enable operations to be conducted under ether anaesthesia

but surgeons would be limited to performing simple procedures since no operation could last more than two hours without great risk of an anaesthetic death.

(v) Analgesics

The alleviation of pain following surgery and for acute, serious and terminally ill people would be a major problem as all analgesics are imported. Considerable suffering could be expected without them.

(vi) Intravenous Fluids

Intravenous fluids are essential for surgical procedures as they replace fluids lost during operations. Any shortage of these fluids would result in a curtailment of surgery.

Effects of EMP

An EMP would affect the supply of medicines within New Zealand. Local manufacture of pharmaceuticals would be hindered by any cuts in electricity as manual methods of manufacture would have to replace electrically-operated mixers and tablet-forming machines.

The distribution of medicines to warehouses, hospitals, pharmacies and the public, particularly in the South Island, would be made difficult if an EMP disrupted transport systems, since the pharmaceutical supply network is concentrated in the Auckland area.

Vaccines and other drugs with short shelf-lives require refrigeration and their efficacy would be weakened if electricity failed. Vaccines usually last at normal room temperature for about seven days after which time they have to be disposed of.

Medical Devices and Equipment

A loss of trade with the Northern Hemisphere would curtail the supply of a wide range of medical devices and equipment which, over time, would seriously restrict diagnostic services, surgical practice and disease management.

Supplies of radiopharmaceuticals, the majority of which are imported from the Northern Hemisphere, would cease immediately as their short half-lives mean only limited stocks are held. As a consequence, important diagnostic work would stop. Some kinds of radioisotopes could be obtained from Australia if trade was possible (Physicist, Canterbury Hospital Board).

After one month, supplies of X-ray film would be depleted and many radiological examinations could not be performed. Radiology would be possible using fluoroscopy and ultra-sound although accuracy would be reduced. For a limited period, stocks could be supplemented by importing film from Australia but when raw materials imported from the United States were used up, even Australian manufacturing of X-ray film would be impossible (Physicist, Canterbury Hospital Board). However, recycling of X-ray film emulsion and celluloid may be possible (Physician, Wellington).

Six months after the cessation of trade, stocks of diagnostic reagents would be exhausted and laboratory work would become limited in scope. Only basic tests,

such as blood counts, urine examinations, and the culture of bacteria, could be performed using indigenous materials.

In the longer term, supplies of barrier methods of contraception - condoms, diaphragms, cervical caps and chemical spermicides - would no longer be available. The loss of imported intra-uterine devices would not be an immediate problem as they can be left safely in place for five years. However, the risk of infection (which increases with partner change and exposure to sexually transmitted diseases) would limit the usefulness of this practice, especially if there were no antibiotics with which to treat IUD-induced infections. Fertility rates would rise as supplies of oral and barrier contraceptives became depleted.

Current medical practice relies heavily on disposable needles and syringes. These are unable to be boiled as they disintegrate when dried. Syringes could be re-used by any individual requiring repeated injections (for example, a diabetic) but in most cases the risk of infection from hepatitis and AIDS would make re-use of needles and syringes unsafe. Old supplies of metal and glass syringes could be brought back into use, although quantities held of these items are unlikely to be large.

Most of the routine surgical instruments come from the Northern Hemisphere but these are fairly durable and lack of replacements would not make an impact for some years. Prosthetic (implant) material is imported and this would affect orthopaedic, cardiac, ophthalmologic and deafness surgery. A lack of endoscopes and operating miroscopes would cause difficulties for the continuation of much ophthalmologic, urologic and ear, nose and throat surgery.

Perhaps the most significant effect of a trade loss would be the lack of replacement parts to maintain sophisticated electronic equipment such as radiotherapy treatment machines, computerized axial tomography (CAT) scanners and other organ-imaging machines. Using the limited stocks of components held, it should be possible to maintain most equipment for periods of 6 months to a few years (Physicist, Canterbury Hospital Board).

X-ray tubes for CAT scanners last 3-4 months. Usually only one spare is held and once this is used, CAT scans would cease. Radiotherapy equipment spares could keep equipment running for up to 3 years. Cobalt units could be used for up to ten years although treatment times would then be excessively long (Physicist, Canterbury Hospital Board).

Effects of EMP

If there was an EMP, this would have an immediate impact on the use of medical equipment and on current medical practice. As soon as the EMP occurred, respirators would fail, incubators would cease functioning and dialysis machines would stop. The majority of patients dependent on these machines would suffer irreparable damage and die.

The dependence of modern medicine on electricity and electronic circuitry means that if equipment was rendered inoperable it would be exceedingly difficult to continue usual surgical programmes, treatment regimes and diagnostic services since essential equipment such as that used for administering anaesthetics, X-rays and scanners, and respiratory and heart monitors would cease to function.

It is not clear what effect an EMP would have on the clouding of X-ray film stock

in unshielded storage. This is a matter which requires further investigation (Radiologist, Wellington).

Any disruptions to transportation would prevent many people from gaining access to particular medical specialties since these are not available in all cities (see Table 1). Treatment and surgery for renal and neurological conditions, for example, would be impossible for people residing at a considerable distance from the hospital in which the specialty is located.

Health workforce

The health workforce would be subject to the same anxieties and disruptions as the rest of the population, and yet individuals would be under great pressure to provide health services. It seems to be a common assumption that nurses and doctors would continue to work, but a nuclear war is unlike any other disaster and it is therefore difficult to predict the reaction of health workers.

Decisions about whether or not to continue working would be influenced by such factors as availability of payment for services (fees or salaries) and the existence of a central authority capable of organising the delivery of health care and directing health workers.

Domestic workers in hospitals are predominantly Maori and many would probably return to their families in rural areas, thereby creating difficulties for hospitals in respect of cleaning services and the maintenance of hygiene. (Centre for Maori Studies - Staff, Waikato University.)

Present regional imbalances in doctor- and nurse-to-patient ratios would mean that in some areas people would not have access to a health care practitioner and that doctors and nurses could become extremely overworked. Retired or former members of the health workforce might be available to assist. For example, it has been estimated that perhaps 30,000 trained nurses no longer hold practising certificates and many of these might be available to assist with health care provision if required (New Zealand Nurses Association).

Many health workers would not be able to get to their places of work if transport systems were disrupted by an EMP. Doctors and nurses might treat and advise people in their local neighbourhoods but this would obviously be a haphazard arrangement and it cannot be assumed that every neighbourhood would be adequately covered.

The most significant impact on health workers, particularly doctors and nurses, would be the gradual loss of their "tools of trade" - that is, medicines and medical supplies - without which they may feel unable to treat illness and disease. This could cause health workers to reconsider their role in, and obligations to, the health system.

Hospitals

The impact of a nuclear war on medical supplies and the health workforce would seriously impair the functioning of all hospitals in New Zealand. The primary objective of hospitals is to provide a site for the diagnosis and treatment of illness and disease, yet the means (medicines, medical devices, surgery, skilled health care workers) for doing so would either be totally unavailable or exist in

a very limited form only.

A new priority system for admission to hospitals would need to be devised and new protocols developed for treatment and nursing care. It would be unlikely for example, that long-stay geriatric patients would have priority in receiving medicines and care if these were in short supply. If infectious disease was widespread, hospitals might have to focus activities on the provision of isolation facilities for infected individuals. Hospitals themselves could become a source of infection. At present, 4-6% of patients develop nosocomial (hospital-acquired) infections and this rate would increase significantly without antibiotics and in unhygienic conditions (*New Zealand Medical Journal*, 11/12/85, p. 1063 and 23/2/83, p. 119).

An EMP would limit the hospital's ability to provide hygienic and comfortable conditions for patients. Electricity is used for heating, hot water, lighting, lifts, cooking and laundries, and although some hospitals have standby generators their voltage regulators could be damaged by EMP. Hospitals are dependent on urban sewage and waste disposal systems and if these break down, it would be exceedingly difficult to maintain sanitary conditions.

Impacts on the health care system - conclusion

It is clear that unless the present health care system would experience considerable strain following a major nuclear war. Without medicines, medical supplies and a workforce, the delivery of health care in its present form would be virtually impossible; that is, neither new health problems (the infectious diseases) nor on-going conditions of ill-health could be adequately dealt with. As a consequence, there would be enormous increases in mortality and morbidity in New Zealand.

RESPONSE OF THE HEALTH CARE SYSTEM TO THE IMPACTS OF NUCLEAR WAR

The present health care system could continue to operate, albeit in a changed form, only if society and the economy continued to function in an orderly manner and only if the government was able to maintain its authority and take responsibility for making decisions of national importance, particularly regarding matters of health.

In the short term, the establishment of a rationing and control system for medical supplies would enable the health service to continue almost in its present form. At the same time, alternative therapies and methods of treatment would be investigated and brought into use. The longer-term response would be to establish a manufacturing capability in New Zealand for selected medicines and medical devices. High-technology medicine would have to give way to a health service engaged upon the *prevention* of ill-health. This new focus would have implications for the work of health sector personnel.

Control of medicines and medical supplies

The imposition of a rationing system for medicines and medical devices and equipment would be essential in order to eke out available stocks for as long as possible. This could be achieved by:

(i) placing *all* stocks (including those stored in private households) under government control and locating them in secure central areas such as hospital pharmacies;

(ii) putting restrictions on prescribing so that use of medicines is minimized;

ii) restricting use of X-rays, laboratory tests, syringes, intravenous fluids and scanners.

There would be problems in instituting such a scheme, the first of which would be to convince the public and health professionals of the need to conserve resources. The impounding of supplies would prove more difficult if communication and transport networks were damaged by an EMP. The major obstacle to the successful operation of a rationing system would be that of determining and enforcing a priority system for treatment.

Decisions that could be made to assist with the conservation of stocks would be to:

- cease treatment of minor disorders;
- eliminate individual medical supplies and substitute with daily attendance at a clinic or nursing station;
- restrict medicines, surgery and care to the treatment of life-threatening conditions where recovery is probable;
- if necessary, further restrict treatment to those people able to contribute most to society.

The implications of setting these rules are that the chronically ill and the elderly would be denied treatment. It might be difficult to justify giving treatment to refugees unless they were suffering from a disease which could be passed on to indigenous New Zealanders.

For some health personnel, compliance with such a scheme would be untenable and could be regarded as incompatible with professional ethics. In this case, rules would be flouted and the rationing system would not survive for any length of time. In any case, even with strict rationing in force, supplies of medicines would be exhausted within six to twelve months.

Alternative therapies and methods

As treatment by mainstream methods became less of a possibility, people would turn to alternative treatments such as herbalism, drug-free therapies such as osteopathy and acupuncture, and traditional forms of healing practised by the Maori. Psychiatrically-disturbed people could be cared for using non-pharmaceutical means of management and restraint, although this would not be appropriate for some severely disturbed people.

Traditional methods of anaesthesia and contraception would be employed, although they are not as effective as modern practices. Simple and relatively safe techniques for administering anaesthetics are the "rag and bottle" and blind intubation procedures. Acupuncture could also be used as a means of anaesthesia.

However, anaesthetists would require training in these methods. Coitus interruptus, temperature detection, the rhythm method and natural sea sponges are all methods of contraception which have been relied upon in the past and which would again be widely practised.

Manufacture of medicines

The manufacture of modern medicines is reliant on highly synthesized chemicals which are at present not produced in New Zealand. However, the expertise, technology and indigenous raw materials (hydrocarbons from oil, plant extract and animal by-products) do exist to produce some of the chemicals required for the local production of medicines. Production would only be on a small scale and the pharmaceutical manufacturing industry would never be able to operate as effectively as at the present time. Equipment currently used by the dairy and brewing industries could be adapted for use in the manufacture of pharmaceuticals. The following medicines could possibly be produced:

(i) Antibiotics

The production of antibiotics from moulds is not technically difficult and the technology is available in New Zealand to produce penicillin. One pharmaceutical company already has penicillin manufacturing facilities in Wellington and estimates that it would take six months or more to produce the base material. It would be more difficult and would take a great deal more time to make other antibiotics, particularly the newer cephalosporins.

(ii) Vaccines

Since animal vaccines are made in New Zealand, use could be made of the technical base and plant to produce human vaccines. However, it could take nine months to develop this ability (animal vaccine manufacturer). Live vaccines against polio and tuberculosis may be relatively easy to produce but it would be extremely difficult and expensive to produce vaccines for diphtheria, tetanus and typhoid.

(iii) Anaesthetics

Diethyl ether for anaesthetics can be readily made from alcohol (ethanol) and sulphuric acid. This is a simple anaesthetic which is easy to administer but it is not suitable for surgery of more than two hours duration. Industrial gases made in New Zealand - nitrous oxide and oxygen - are also used for anaesthesia.

(iv) Medicines Made from Plants

Medicines can be manufactured from indigenous plants using a process known as bio-mass technology in which cells are extracted from plants and grown as a pure culture. This technology is available in New Zealand and could produce medicines to treat a variety of conditions. (Physician, Canterbury Hospital Board.)

Some examples of the plants that could be used for the manufacture of medicines and the uses to which they could be put are:

Plant (Common Name)	Medicinal Extract	Use
poppy	morphine	pain relief
poppy	codeine	pain relief/stops diarrhoea
foxglove	digoxin	heart failure
rauwolfia valerian chamomile	-	minor tranquillisers
rye grass	ergotinetrine	curtailing bleeding in child-birth
ispaghula	-	laxative
willow bark	aspirin	pain relief
dandelion	-	crude diuretics

These plants either grow, or have been grown previously, in New Zealand although not on a commercial scale. Medicinal plants can also be used successfully to treat minor ailments such as coughs, rashes, indigestion and flatulence.

(v) Medicines Made From Animal By-Products

The raw material to produce insulin - that is, sheep pancreas - is readily available in New Zealand. However, the insulin produced would be a crude preparation and its production would be a complicated and time-consuming process. Insulin manufacture would be dependent on the availability of chemicals with which to process the pancreas, and on transportation systems to get sheep to abattoirs and insulin to patients and doctors.

Other animal by-products of use would be adrenal extracts (used by asthmatics), bile products (for gall-stones), pancreatic and pituitary extract. Thyroid extract is vital for people with hypothyroidism. Sheep intestines could be used to make sutures for surgical use.

Conclusion

In the aftermath of a nuclear war, assuming that there was no EMP effect or that equipment damaged by an EMP could be restored, New Zealand would have the ability to set up a small-scale pharmaceutical industry using indigenous materials. However, locally-produced products would not fully replace imported medicines. Drugs derived from natural bases are usually not as effective as synthetic drugs - modern antibiotics, for example, are more effective than alternatives made from medicinal plants. Some drugs are difficult to manufacture (for example, drugs to treat epilepsy, asthma and Parkinson's disease, diuretics and anti-hypertension

drugs) and there are no known adequate substitutes.

If medicines were to be manufactured locally it would first of all be necessary to identify which medicines should be produced. Priority would have to be given to essential medicines such as antibiotics and vaccines as these have life-saving capacity and are the medicines most needed to deal with infectious diseases.

A new direction for the health care system and changed roles for the health workforce

Given that rationing, alternative therapies and locally manufactured medicines would be rather limited in their ability to combat New Zealand's health problems following a major nuclear war, the health care system would have to respond to a changing society and the threat of epidemics by other means. The most appropriate and effective response that could be made would be a re-orientation of focus from medical intervention to *preventive medicine*, where the promotion of good health and healthy practices is emphasized and where health education assumes primary importance.

To ensure that people had access to health education and health care, the health workforce would need to move out of hospitals and into the community. Health workers would need to have practical skills in low technology care - first aid, herbal medicine (especially for pain relief), midwifery, basic surgery and counselling.

For nurses, this change of duties would constitute an expansion of their present role but for large numbers of the medical profession (at the present time approximately only one-third are in general practice), re-training in the skills of general practice and in the prevention and control of communicable diseases would be required.

The immediate priority for health workers would be to rapidly disseminate information regarding measures that should be taken to:

(i) prevent the spread of infectious disease;

(ii) reduce exposure to radiation and ultraviolet light;

(iii) relieve anxiety and stress;

(iv) avoid unwanted pregnancy;

(v) maintain a healthy diet.

People would have to be encouraged to take responsibility for their own health and health needs.

Mental health workers would have an important role in the community providing counselling, stress-management advice and assisting people to cope with grief and anxiety. These workers would be instrumental in setting up support networks which would enhance social cohesion and reduce the possibility of widespread social disorder.

PRE-NUCLEAR WAR PLANNING

A major nuclear war in the Northern Hemisphere with some targets in Australia would have a profound impact on, and grave consequences for, health and the health care system in New Zealand. However, certain measures could be taken now that would lessen the impacts. Listed below are preparatory activitites identified as being of critical importance in assisting the health service to deal with the problems it would have to confront.

(i) Medicines

- Obtaining stocks of potassium iodate tablets sufficient for the entire New Zealand population
- Preparing a list of essential medicines
- Completing a national inventory of essential medicines
- Stock-piling essential medicines (especially vaccines and antibiotics) taking into account shelf-life of the medicines by rotating the stock
- Commencing local production of antibiotics
- Investigating the possibility of establishing a pharmaceutical manufacturing industry using indigenous raw materials
- Acquiring details of medicine manufacturing methods
- Studying health care provided by "alternative" health practitioners.

Comment:

Several individuals have prepared lists of essential medicines. The most important classes of drugs required post-nuclear war would be analgesics, antibiotics, vaccines and anesthetics. One possible list is provided in the Appendix.

The Health Services Research and Development Unit has undertaken a preliminary study of the issues involved in the provision of "alternative" health care. Some recommendations have been made regarding a follow-up study on the efficacy of "alternative" medicine.

(ii) Medical Devices and Equipment

- Preparing a list of essential medical devices and equipment
- Preparing a national inventory of essential supplies
- Stock-piling essential medical devices and spare parts for equipment.

(iii) Health Workforce

- Establishing a register of all present and former health workers (including

"alternative" health practitioners) and their skills

- Develop training programmes for health workers (nurses, doctors, pharmacists) that emphasise preventive medicine and basic health care skills
- Preparing a contingency plan for retraining and redeployment of the health workforce.

(iv) Health Education

- Investigating a means of efficient and effective communication of health matters to the general public
- Commencing health education programmes for the public and health workforce personnel on matters of basic hygiene, prevention of communicable disease, and exposure to radiation
- Preparing and distributing to all households a guide or pamphlet providing advice on health care following a nuclear war.

Comment:

Dr N. Wilson (Physician, Auckland) has produced an informative 'How to Stay Healthy' document which includes important information about hygiene, nutrition, mental health, reproductive health and infectious disease. This could be adapted for widespread distribution.

Health Planning Committee

A nuclear war health planning committee with responsibility for implementing the above measures should be established. This committee would:

(i) determine which medicines and medical supplies are essential for stockpiling and/or manufacturing;

(ii) decide upon quantities of supplies to be stockpiled and locations for storage;

(iii) develop a plan for the security and control of resources;

(iv) devise a distribution system for medicines, medical devices and equipment;

(v) draw up a protocol for determining for whom, and for what medical conditions, health care (diagnosis and treatment) would be provided following a nuclear war;

(vi) encourage the development of contingency plans for emergency water supplies, alternative sewage disposal, and food supply and distribution systems.

The Health Department has begun work on a health sector contingency plan which could be considered by a health planning committee and incorporated in the overall planning for a nuclear war.

FURTHER RESEARCH REQUIREMENTS

Research conducted overseas shows that radiation impairs the functioning of the immune system and that this increases the individual's susceptibility to infection (*New England Journal of Medicine*, October 1986). However, these studies are primarily concerned with effects from a direct blast producing high levels of radiation. It is difficult to estimate what effect fallout from an Australian detonation would have on the immune systems of New Zealanders. Further research is required to examine the effect on health of low levels of radioactivity.

Another area not addressed in detail is the damage intense ultraviolet light can cause to eyes.

These issues should be examined in order that any necessary planning can be undertaken as soon as possible.

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APPENDIX

Proposed list of essential drugs for dealing with acute illness in an otherwise normal population

1. For Pain

morphine
paracetamol
aspirin

2. Anaesthetics

thiopentone sodium
suxamethonium chloride
halothane
lignocaine 1%

3. For Acute gastrointestinal problems

oral rehydration solution) these could be easily be prepared from likely
intravenous saline) existing stocks of salts
intravenous saline and dextrose)
metoclopramide

4. Infection

augmentin
doxycycline
cotrimoxazole
cefuroxamine
metronidazole

5. Psychiatric

thioridazine
amitriptyline
lithium carbonate
lorazepam

6. For Skin

corticosteroid cream (Locoid Lipocream recommended)
emulsifying ointment
ultraviolet ultrablock

7. For Eyes

ophthalmic gentamicin
ophthalmic local anaesthetic (e.g. Xylocaine 4%)
ophthalmic steroid (e.g. Predforte)

8. Miscellaneous

oral contraceptive
frusemide
prednisone
salbutamol solution for nebulising
dextrochlorpheniramine maleate
adrenaline injection 1 in 1000
ergometrine maleate injection

Justification for proposed list

This list is made in relation to present patterns of acute illness in New Zealand and those that might be worsened by the environmental changes in a northern nuclear war. The implications of an influx of refugees have not been included.

The main problems afflicting a normal population would probably be trauma, infection, diarrhoea and vomiting, acute psychiatric problems and problems of the eye and skin. General or local anaesthesia might be needed to deal with some of these acute events.

It seems important that we should be able to deal adequately with pain. While morphine is appropriate for the majority of severe pain, paracetamol and aspirin have both been included, the first being better tolerated by many people with gastrointestinal problems, and by children, whilst here. aspirin has additional anti-inflammatory effects and thus a wider usefulness.

Under the heading **Anaesthetics** the more conventional suggestion of thiopentone sodium has replaced an earlier suggestion, after further discussion with specialists. Also, although a previous suggestion of Vecuronium as a paralysing agent was justified by its short duration of action, it is inordinately expensive, and therefore does not really have a place on this list. Suxamethonium, a more conventional brief relaxing agent has been included instead. Halothane for inhalational anaesthesia and lignocaine for local anaesthesia are standard.

Diarrhoea and vomiting would be the most common acute gastrointestinal problems, both of which are best treated by oral or intravenous re-hydration. It is probable that these could be made locally, as they contain various salts and glucose that would be available in good quantity here. Morphine in its oral form would be an appropriate treatment for some diarrhoeal diseases. Metoclopramide is desirable for supressing nausea and/or vomiting.

The antibiotics selected are, with one exception, given by mouth. The selection covers a wide range of organisms, including those such as chlamydia and anaerobes.

As acute anxiety and depression would be likely to be prominent, and disturbed people very distressing to themselves and those around them, drugs are included to deal with depression, acute psychosis and severe anxiety.

To deal with the increased ultra-violet light expected, sunhats and clothing are the most effective. However if an ultra-violet blocker were to be recommended, then UV ultrablock is an effective screen against both B and C ultra-violet light. Local therapy for skin inflammation (a steroid cream) and simple emulsifying

ointment have been included.

For the eyes the simple first-aid remedies needed would be a local anaesthetic preparation, a wide-spectrum antibiotic preparation and a local steroid.

Contraceptive steroid medication has been included as it may be desirable to recommend a period of reduced fertility in a post-nuclear war era.

"It seems to me that the reason that we make none of the active ingredients of drugs in New Zealand is lack of willing, or legal hurdles, rather than lack of ability. Within our industry and academic institutions the ability is certainly there, but on the whole it's not in the interests of Multi-national Companies to initiate this." (New Zealand pharmaceutical manufacturer.)

On the other hand, many companies in New Zealand have the ability to transform active ingredients into finished products, and that is being done all the time. Therefore, that step in the process would not be a problem as long as the active ingredients were available.

"I gather that most companies keep about three months supply of any agent here, so we would soon run out of everything in the event of a Northern Hemisphere nuclear war. We cannot sensibly stock-pile drugs in their finished form as their shelf life is very much dependent upon the other components in the product, and most will last only for a couple of years. On the other hand the active ingredient stored will last indefinitely; though it may lose a little of its potency, that can be assessed by assay before tableting. However we are still talking about large quantities, e.g. ...we get through five tonnes of flucloxacillin annually in New Zealand. I don't believe that's all necessary by any means, and it actually isn't on my list of essentials though many people would argue that it should be.

"If a list such as the one I have produced were adhered to strictly, I expect we could stockpile sufficient of those active ingredients at a cost of only a few million dollars, to last for five years say. However the logic of the situation seems to be that self-sufficiency should be sought in this matter." (R.H. Briant.)