WAI 2500 THE MILITARY VETERANS KAUPAPA INQUIRY
INDEX TO APPENDICES FOR THE BRIEF OF EVIDENCE
OF ROSLYN NEPIA HIMONA

DATED: 20TH JUNE 2016

BRIEF OF EVIDENCE
MAJOR (RETD) R.N.HIMONA RNZIR

Appendix 1: Qualifying Operational Service

Current Recognised Wars and Emergencies

(as at 10 June 2014)

War and Emergency	Dates covered
First World War	4 August 1914 to 11 November 1918
Second World War	3 September 1939 to 14 August 1945
Mercantile Marine (Merchant Navy)	3 September 1939 to 14 August 1945
Occupation Force of Japan (J Force)	14 August 1946 to 28 April 1952
Berlin Airlift	1 September 1948 to 11 August 1949
Korean War (K Force)	23 August 1950 to 27 July 1957
United Nations Military Observer Group in India and Pakistan (UNMOGIP); and United Nations India-Pakistan Observation Mission (UNIPOM)	January 1952 to 31 March 1974
United Nations Truce Supervision Organisation (UNTSO), and its detachments: United Nations Yemen Observer Mission (UNYOM); and United Nations Observation Group in Lebanon (UNOGIL); and United Nations Operation in the Congo (UNOC) United Nations Emergency Force (UNEF I) Second United Nations Emergency Force (UNEF II) United Nations Disengagement Observer Force (UNDOF) United Nations Interim Force in Lebanon (UNIFIL) United Nations Iran-Iraq Military Observer Group (UNIIMOG)	July 1954 to 31 March 1974 1956 to 1957 October 1973 to 1979 1974 to current 1978 to current July 1988 to 28 February 1991
Operation Grapple (Christmas & Malden Islands)	HMNZS Rotoiti 15 May 1957 to 8 November 1957; and HMNZS Pukaki 15 May 1957 to 8 November 1957 and 28 April 1958 to 23 September 1958
The Malayan Emergency	18 June 1948 to 31 July 1960
Thai/Malay Border	31 July 1960 to June 1964
Indonesian Confrontation (including Borneo)	1 August 1964 to 31 December 1966
Vietnam: Civilian surgical team at the Qui Nhon Provincial State Hospital Vietnam War 41 Squadron RNZAF	 December 1963 to March 1975 29 May 1964 to 31 December 1972 1 January 1973 to 21 April 1975
Cyprus - United Nations Peacekeeping Force in Cyprus (UNFICYP)	May 1964 to June 1967
Mururoa (Nuclear Testing)	22 July 1973 on HMNZS Otago; and 28 July 1973 on HMNZS Canterbury
Rhodesia - Commonwealth Monitoring Force (CMF) Operation Midford	23 December 1979 to 5 March 1980
Gulf Conflict	20 December 1990 to 13 April 1991
Afghanistan: United Nations Mine Clearing Training Team (UNMCTT) Deployed outside the territory of New Zealand as part of Operation Enduring Freedom	 1 January 1991 to 31 December 1991 12 December 2001 to present

Current Recognised Wars and Emergencies

(as at 10 June 2014)

War and Emergency	Dates covered
Iraq: United Nations Special Commission (UNSCOM) United Nations Monitoring Verification and Inspection Commission (UNMOVIC) Iraq War	 19 April 1991 to 17 December 1999 November 2002 to 28 March 2003 1 September 2003 to present
Angola: United Nations Verification Missions in Angola (UNAVEM II & III); and United Nations Observer Mission in Angola (MONUA); and National Institute for the Removal of Obstacles and Explosive Ordinance in Angola (INAROEE)	 July 1991 to June 1999
Cambodia: United Nations Advance Mission in Cambodia (UNAMIC) Cambodian Mine Action Centre (CMAC) or Mine Clearance Training Unit (MCTU) United Nations Transitional Authority in Cambodia (UNTAC)	 October 1991 to March 1992 December 1991 to 3 November 1993 February 1992 to September 1993
Bosnia - United Nations Protection Force (UNPROFOR)	23 March 1992 to present
Somalia: United Nations Operations in Somalia (UNOSOM & UNOSOM II); and United Task Force (UNITAF)	 January 1993 to March 1995
Haiti - United Nations Mission in Haiti (UNMIH)	19 September 1994 to 31 March 1995
Bougainville: South Pacific Peacekeeping Force (SPPKF) Truce Monitoring Group (TMG) Peace Monitoring Group (PMG)	 September 1994 to October 1994 October 1997 to April 1998 May 1998 to 30 June 2003
Papua New Guinea - Tsunami (Medical Team)	July 1998
Sierra Leone: United Nations Observers Mission in Sierra Leone (UNOMSIL); and United Nations Mission in Sierra Leone (UNAMSIL)	 11 August 1998 to present
Kosovo: KOSMED NATO Kosovo Force (KFOR)	 1999 2002
New Zealand Defence Personnel deployed to East Timor	30 August 1999 to present
Solomon Islands	July 2003 to present
Banda Aceh - Operation Sumatra Assist	27 December 2004 to 28 February 2005
Sudan: United Nations Mission in Sudan (UNMIS) United Nations Mission in Southern Sudan (UNMISS)	 17 September 2005 to 9 July 2011 9 July 2011 to present
Lebanon - United Nations Mine Action Coordination Centre in Southern Lebanon (UNMACC SL)	11 February 2007 to 7 February 2008
Syria - United Nations Supervision Mission in Syria (UNSMIS)	22 May 2012 to 22 August 2012

Appendix 2: Complete List of Conditions Covered by Statements of Principles.

Statements of Principles

Blood and Blood-forming Organs

- aplastic anaemia
- essential thrombocythaemia
- methaemoglobinaemia
- myelodysplastic syndrome (previously known as: myelodysplastic disorder)
- polycythaemia vera
- primary myelofibrosis
- sarcoidosis
- sickle-cell disorder

Circulatory System

- acute rheumatic fever
- aortic aneurysm
- aortic stenosis
- atherosclerotic peripheral vascular disease
- atrial fibrillation and atrial flutter (previously known as: atrial fibrillation, atrial flutter)
- cardiac myxoma
- cardiomyopathy (previously known as: cardiomyopathy, familial hypertrophic cardiomyopathy)
- carotid arterial disease
- cerebrovascular accident
- chronic venous insufficiency of the lower limb
- deep vein thrombosis
- fibromuscular dysplasia
- giant cell arteritis
- heart block
- hypertension
- immune thrombocytopaenic purpura (previously known as: idiopathic thrombocytopaenic purpura)
- ischaemic heart disease
- mitral valve prolapse
- non-aneurysmal aortic atherosclerotic disease (previously known as: aortic atherosclerotic disease)
- pulmonary thromboembolism
- renal artery atherosclerotic disease
- retinal vascular occlusive disease
- rheumatic heart disease
- sick sinus syndrome
- subarachnoid haemorrhage
- subdural haematoma

- thromboangiitis obliterans (previously known as: Buerger's disease)
- varicocele
- varicose veins of the lower limb

Congenital Anomalies / Hereditary Conditions

- albinism
- alpha-1 antitrypsin deficiency
- autosomal dominant polycystic kidney disease (previously known as: polycystic kidney disease)
- Charcot-Marie-Tooth disease
- Gaucher's disease
- haemochromatosis
- haemophilia
- hereditary spherocytosis
- horseshoe kidney
- Huntington's chorea
- Marfan syndrome
- multiple osteochondromatosis
- osteogenesis imperfecta
- sickle-cell disorder
- von Willebrand's disease
- Wilson's disease

Digestive System

- acute pancreatitis
- anal fissure
- cholelithiasis
- chronic gastritis and chronic gastropathy
- chronic pancreatitis
- cirrhosis of the liver
- coeliac disease
- dental caries
- dental malocclusion
- dental pulp and apical disease
- diverticular disease of the colon
- familial adenomatous polyposis (previously known as: colorectal adenomatous polyp or familial adenomatous polyposis)
- gastric ulcer and duodenal ulcer (previously known as: peptic ulcer disease)
- gastro-oesophageal reflux disease
- gingivitis
- hiatus hernia
- inflammatory bowel disease
- inguinal hernia
- irritable bowel syndrome

- loss of teeth
- periodontal abscess
- periodontitis (previously known as: inflammatory periodontal disease)
- peritoneal adhesions
- steatohepatitis

Endocrine, Nutritional, Metabolic Diseases

- acute rheumatic fever
- adrenal insufficiency
- Cushing's syndrome
- diabetes mellitus
- goitre
- gout
- Graves' disease
- haemochromatosis
- Hashimoto's thyroiditis
- hyperthyroidism and thyrotoxicosis
- hypopituitarism
- hypothyroidism
- microscopic polyangiitis
- morbid obesity
- polyarteritis nodosa
- porphyria cutanea tarda
- systemic lupus erythematosus

Genitourinary System

- analgesic nephropathy
- benign prostatic hyperplasia
- chronic pruritus ani (previously known as: pruritus ani)
- endometriosis
- erectile dysfunction (previously known as: impotence)
- haemorrhoids
- mesangial IgA glomerulonephritis
- obstructive and reflux nephropathy (previously known as: obstructive nephropathy)
- rapidly progressive crescentic glomerulonephritis
- renal stone disease (previously known as: nephrolithiasis, ureteric calculus)
- varicocele

Infectious and Parasitic Diseases

- acute infectious mononucleosis (previously known as: symptomatic Epstein-Barr virus infection, symptomatic Epstein-Barr virus infection)
- ascariasis
- chickenpox

- clonorchiasis
- dengue fever
- hepatitis A
- hepatitis B
- hepatitis C
- hepatitis D
- hepatitis E
- herpes simplex
- herpes zoster
- hookworm disease (previously known as: ancylostomiasis)
- human immunodeficiency virus
- human T-cell lymphotropic virus type 1
- influenza
- leptospirosis
- Lyme disease
- malaria
- melioidosis
- opisthorchiasis
- osteomyelitis
- Ross River virus infection (previously known as: Ross River fever)
- schistosomiasis
- scrub typhus
- smallpox
- strongyloidiasis
- tinea
- tuberculosis

Injury

- accidental hypothermia
- acute articular cartilage tear
- acute meniscal tear of the knee
- animal envenomation
- chilblains
- concussion
- cut, stab, abrasion and laceration
- decompression sickness (previously known as: caisson disease)
- dislocation
- dysbaric osteonecrosis
- electrical injury (previously known as: Effects of lighting , non fatal effects of electric shock and death from electrocution)
- external bruise (previously known as: external bruises and external contusions)
- external burn
- fracture

- frostbite
- iliotibial band syndrome
- immersion foot
- joint instability
- labral tear
- moderate to severe traumatic brain injury
- otitic barotrauma
- physical injury due to munitions discharge (previously known as: gunshot wounds)
- poisoning and toxic reaction from plants and fungi
- pulmonary barotrauma
- sinus barotrauma
- sprain and strain
- suicide and attempted suicide

Mental Disorders

- acute stress disorder
- adjustment disorder
- alcohol use disorder (previously known as: alcohol dependence and alcohol abuse, alcohol dependence or alcohol abuse, psychoactive substance abuse or dependence)
- anxiety disorder (previously known as: anxiety disorder due to a general medical condition, generalised anxiety disorder)
- bipolar disorder
- chronic multisymptom illness
- depressive disorder
- eating disorder
- panic disorder
- personality disorder
- posttraumatic stress disorder
- schizophrenia
- somatic symptom disorder
- substance use disorder (previously known as: drug dependence and drug abuse)
- suicide and attempted suicide

Musculoskeletal System and Connective Tissue

- Achilles tendinopathy and bursitis (previously known as: Achilles tendonitis or bursitis)
- acute articular cartilage tear
- acute meniscal tear of the knee
- adhesive capsulitis of the shoulder
- ankylosing spondylitis
- cervical spondylosis

- chondromalacia patella
- chronic multisymptom illness
- dermatomyositis
- discoid lupus erythematosus
- dislocation
- Dupuytren's disease
- dysbaric osteonecrosis
- epicondylitis
- fibromyalgia
- hallux valgus (previously known as: acquired hallux valgus, congenital hallux valgus)
- heel bursitis (previously known as: posterior adventitial heel bursitis)
- iliotibial band syndrome
- inflammatory bowel disease
- internal derangement of the knee
- intervertebral disc prolapse
- joint instability
- labral tear
- localised sclerosis
- lumbar spondylosis
- osteoarthritis (previously known as: osteoarthrosis)
- osteomyelitis
- osteoporosis
- Paget's disease of bone
- patellar tendinopathy
- pes planus (previously known as: acquired pes planus, acquired pes planus and congenital pes planus, congenital pes planus)
- plantar fasciitis
- polymyalgia rheumatica
- psoriatic arthropathy
- rapidly progressive crescentic glomerulonephritis
- reactive arthritis (previously known as: Reiter's syndrome)
- relapsing polychondritis
- rheumatoid arthritis
- rotator cuff syndrome
- shin splints
- somatic symptom disorder
- spasmodic torticollis
- spondylolisthesis and spondylolysis
- systemic sclerosis
- thoracic spondylosis
- trochanteric bursitis and gluteal tendinopathy

Neoplasms

- acoustic neuroma
- acute lymphoblastic leukaemia (previously known as: acute lymphoid leukaemia)
- acute myeloid leukaemia
- adenocarcinoma of the kidney
- benign neoplasm of the eye and adnexa
- cerebral meningioma
- chronic lymphocytic leukaemia/small lymphocytic lymphoma (previously known as: chronic lymphoid leukaemia)
- chronic myeloid leukaemia
- colorectal adenoma
- Hodgkin's lymphoma (previously known as: Hodgkin's disease)
- Kaposi's sarcoma
- lipoma
- malignant melanoma of the skin
- malignant neoplasm of bone and articular cartilage
- malignant neoplasm of the anus and anal canal
- malignant neoplasm of the bile duct (previously known as: cholangiocarcinoma)
- malignant neoplasm of the bladder
- malignant neoplasm of the brain
- malignant neoplasm of the breast
- malignant neoplasm of the cerebral meninges
- malignant neoplasm of the cervix
- malignant neoplasm of the colorectum (previously known as: malignant neoplasm of the colon, malignant neoplasm of the rectum)
- malignant neoplasm of the endometrium
- malignant neoplasm of the eye
- malignant neoplasm of the gallbladder
- malignant neoplasm of the larynx
- malignant neoplasm of the liver
- malignant neoplasm of the lung
- malignant neoplasm of the nasopharynx
- malignant neoplasm of the oesophagus
- malignant neoplasm of the oral cavity, oropharynx and hypopharynx (previously known as: malignant neoplasm of the oral cavity)
- malignant neoplasm of the ovary
- malignant neoplasm of the pancreas
- malignant neoplasm of the prostate
- malignant neoplasm of the renal pelvis and ureter
- malignant neoplasm of the salivary gland
- malignant neoplasm of the small intestine
- malignant neoplasm of the stomach

- malignant neoplasm of the testis and paratesticular tissues
- malignant neoplasm of the thyroid gland
- malignant neoplasm of the urethra
- malignant neoplasm of unknown primary site
- mesothelioma
- multiple osteochondromatosis
- myeloma (previously known as: multiple myeloma)
- neoplasm of the pituitary gland
- non-Hodgkin's lymphoma
- non-melanotic malignant neoplasm of the skin
- soft tissue sarcoma

Nervous System, Sense Organs

- accommodation disorder
- acquired cataract
- Alzheimer-type dementia (previously known as: Alzheimer's disease)
- angle-closure glaucoma
- anosmia
- arachnoid cyst
- blepharitis (previously known as: acute blepharitis, acute blepharitis, chronic blepharitis, chronic blepharitis)
- carpal tunnel syndrome
- cerebrovascular accident
- chronic fatigue syndrome
- chronic multisymptom illness
- chronic solvent encephalopathy (previously known as: solvent related chronic encephalopathy)
- cluster headache
- concussion
- conductive hearing loss
- conjunctivitis
- Creutzfeldt-Jakob disease
- dementia pugilistica
- epilepsy
- epileptic seizure
- Guillain-Barre syndrome
- macular degeneration
- Meniere's disease
- migraine
- moderate to severe traumatic brain injury
- Morton's metatarsalgia
- motor neurone disease
- multiple sclerosis
- myasthenia gravis

- myopia, hypermetropia and astigmatism (previously known as: refractive error)
- narcolepsy
- open-angle glaucoma
- optochiasmatic arachnoiditis
- otitis externa
- otitis media
- otosclerosis
- Parkinson’s disease and secondary parkinsonism (previously known as: Parkinson's disease, Parkinson's disease and Parkinson's syndrome, Parkinson's disease and parkinsonism, secondary parkinsonism, secondary parkinsonism)
- periodic limb movement disorder
- peripheral neuropathy
- pinguecula
- presbyopia
- pterygium
- restless legs syndrome
- sensorineural hearing loss
- spinal adhesive arachnoiditis
- subarachnoid haemorrhage
- subdural haematoma
- tension-type headache
- tinnitus
- toxic maculopathy
- trigeminal neuralgia
- trigeminal neuropathy
- vascular dementia

Other

- allergic rhinitis
- conjunctivitis
- sudden unexplained death (previously known as: sudden unexpected death)

Respiratory System

- allergic rhinitis
- asbestosis
- asthma
- bronchiectasis
- bronchiolitis obliterans organising pneumonia
- chronic obstructive pulmonary disease (previously known as: chronic airflow limitation, chronic bronchitis and emphysema)
- extrinsic allergic alveolitis

- fibrosing interstitial lung disease (previously known as: idiopathic fibrosing alveolitis)
- pleural plaque
- sinusitis (previously known as: acute sinusitis, chronic sinusitis, chronic sinusitis)
- sleep apnoea

Skin and Subcutaneous Tissue

- allergic contact dermatitis (previously known as: contact dermatitis)
- chloracne
- dermatomyositis
- discoid lupus erythematosus
- ingrowing nail (previously known as: ingrown toenail)
- irritant contact dermatitis (previously known as: contact dermatitis)
- localised sclerosis
- photocontact dermatitis
- pilonidal sinus
- porphyria cutanea tarda
- psoriasis
- psoriatic arthropathy
- reactive arthritis (previously known as: Reiter's syndrome)
- relapsing polychondritis
- rheumatoid arthritis
- seborrhoeic dermatitis
- seborrhoeic keratosis
- solar keratosis (previously known as: chronic solar skin damage)
- systemic sclerosis
- warts

Appendix 3: Statements of Principles for PTSD.

Australian Government
Repatriation Medical Authority

Statement of Principles
concerning

POSTTRAUMATIC STRESS DISORDER

No. 83 of 2014

for the purposes of the

Veterans' Entitlements Act 1986
and
Military Rehabilitation and Compensation Act 2004

Title

1. This Instrument may be cited as Statement of Principles concerning posttraumatic stress disorder No. 83 of 2014.

Determination

2. The Repatriation Medical Authority under subsection **196B(3)** and **(8)** of the *Veterans' Entitlements Act 1986* (the VEA):

(a) revokes Instrument No. 6 of 2008 concerning posttraumatic stress disorder; and

(b) determines in its place this Statement of Principles.

Kind of injury, disease or death

3. (a) This Statement of Principles is about **posttraumatic stress disorder** and **death from posttraumatic stress disorder**.

(b) For the purposes of this Statement of Principles, **"posttraumatic stress disorder"** means a psychiatric disorder which meets the following criteria (derived from DSM-5):

A. Exposure to actual or threatened death, serious injury, or sexual violence in one (or more) of the following ways:

(i) directly experiencing the traumatic event(s);

(ii) witnessing, in person, the event(s) as it occurred to others;

(iii) learning that the traumatic event(s) occurred to a close family member or close friend. In cases of actual or threatened death of a family member or friend, the event(s) must have been violent or accidental; or

(iv) experiencing repeated or extreme exposure to aversive details of the traumatic event(s) (for example, first responders collecting human remains; police officers repeatedly exposed to details of child abuse). This criterion does not apply to exposure through electronic media, television, movies, or pictures, unless this exposure is work related; and

B. Presence of one (or more) of the following intrusion symptoms associated with the traumatic event(s), beginning after the traumatic event(s) occurred:

(i) recurrent, involuntary, and intrusive distressing memories of the traumatic event(s). In children older than six years, repetitive play may occur in which themes or aspects of the traumatic event(s) are expressed;

(ii) recurrent distressing dreams in which the content and/or affect of the dream are related to the traumatic event(s). In children, there may be frightening dreams without recognisable content;

(iii) dissociative reactions (for example, flashbacks) in which the individual feels or acts as if the traumatic event(s) were recurring. (Such reactions may occur on a continuum, with the most extreme expression being a complete loss of awareness of present surroundings.) In children, trauma-specific reenactment may occur in play;

(iv) intense or prolonged psychological distress at exposure to internal or external cues that symbolise or resemble an aspect of the traumatic event(s); or

(v) marked physiological reactions to internal or external cues that symbolise or resemble an aspect of the traumatic event(s); and

C. Persistent avoidance of stimuli associated with the traumatic event(s), beginning after the traumatic event(s) occurred, as evidenced by one or both of the following:

(i) avoidance of or efforts to avoid distressing memories, thoughts, or feelings about or closely associated with the traumatic event(s); or

(ii) avoidance of or efforts to avoid external reminders (people, places, conversations, activities, objects, situations) that arouse distressing memories, thoughts, or feelings about or closely associated with the traumatic event(s); and

D. Negative alterations in cognitions and mood associated with the traumatic event(s), beginning or worsening after the traumatic event(s) occurred, as evidenced by two (or more) of the following:

(i) inability to remember an important aspect of the traumatic event(s) (typically due to dissociative amnesia and not to other factors such as head injury, alcohol, or drugs);

(ii) persistent and exaggerated negative beliefs or expectations about oneself, others, or the world (for example, "I am bad", "None can be trusted", "The world is completely dangerous", "My whole nervous system is permanently ruined");

(iii) persistent, distorted cognitions about the cause or consequences of the traumatic event(s) that lead the individual to blame himself/herself or others;

(iv) persistent negative emotional state (for example, fear, horror, anger, guilt, or shame);

(v) markedly diminished interest or participation in significant activities;

(vi) feelings of detachment or estrangement from others; or

(vii) persistent inability to experience positive emotions (for example, inability to experience happiness, satisfaction, or loving feelings); and

E. Marked alterations in arousal and reactivity associated with the traumatic event(s), beginning or worsening after the traumatic event(s) occurred, as evidenced by two (or more) of the following:

(i) irritable behaviour and angry outbursts (with little or no provocation) typically expressed as verbal or physical aggression toward people or objects;

(ii) reckless or self-destructive behavior;

(iii) hypervigilance;

(iv) exaggerated startle response;

(v) problems with concentration; or

(vi) sleep disturbance (for example, difficulty falling or staying asleep or restless sleep); and

F. Duration of the disturbance (Criteria B, C, D, and E) is more than 1 month; and

G. The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning; and

H. The disturbance is not attributable to the physiological effects of a substance (for example, medication, alcohol) or another medical condition.

(c) Posttraumatic stress disorder attracts ICD-10-AM code F43.1.

(d) In the application of this Statement of Principles, the definition of **"posttraumatic stress disorder"** is that given at paragraph 3(b) above.

Basis for determining the factors

4. On the sound medical-scientific evidence available, the Repatriation Medical Authority is of the view that it is more probable than not that **posttraumatic stress disorder** and **death from posttraumatic stress disorder** can be related to relevant service rendered by veterans or members of the Forces under the VEA, or members under the *Military Rehabilitation and Compensation Act 2004* (the MRCA).

Factors that must be related to service

5. Subject to clause 7, at least one of the factors set out in clause 6 must be related to the relevant service rendered by the person.

Factors

6. The factor that must exist before it can be said that, on the balance of probabilities, **posttraumatic stress disorder** or **death from posttraumatic stress disorder** is connected with the circumstances of a person's relevant service is:

(a) experiencing a category 1A stressor before the clinical onset of posttraumatic stress disorder; or

(b) experiencing a category 1B stressor before the clinical onset of posttraumatic stress disorder; or

(c) having a significant other who experiences a category 1A stressor within the six months before the clinical onset of posttraumatic stress disorder; or

(d) experiencing the traumatic death of a significant other within the one year before the clinical onset of posttraumatic stress disorder; or

(e) being exposed to repeated or extreme aversive details of severe traumatic events before the clinical onset of posttraumatic stress disorder; or

(f) being the victim of severe childhood abuse before the clinical onset of posttraumatic stress disorder; or

(g) experiencing a category 1A stressor before the clinical worsening of posttraumatic stress disorder; or

(h) experiencing a category 1B stressor before the clinical worsening of posttraumatic stress disorder; or

(i) having a significant other who experiences a category 1A stressor within the six months before the clinical worsening of posttraumatic stress disorder; or

(j) experiencing the traumatic death of a significant other within the one year before the clinical worsening of posttraumatic stress disorder; or

(k) being exposed to repeated or extreme aversive details of severe traumatic events before the clinical worsening of posttraumatic stress disorder; or

(l) being the victim of severe childhood abuse before the clinical worsening of posttraumatic stress disorder; or

(m) inability to obtain appropriate clinical management for posttraumatic stress disorder.

Factors that apply only to material contribution or aggravation

7. Paragraphs **6(g) to 6(m)** apply only to material contribution to, or aggravation of, posttraumatic stress disorder where the person's posttraumatic stress disorder was suffered or contracted before or during (but not arising out of) the person's relevant service.

Inclusion of Statements of Principles

8. In this Statement of Principles if a relevant factor applies and that factor includes an injury or disease in respect of which there is a Statement of Principles then the factors in that last mentioned Statement of Principles apply in accordance with the terms of that Statement of Principles as in force from time to time.

Other definitions

9. For the purposes of this Statement of Principles:

"a category 1A stressor" means one of the following severe traumatic events:

(a) experiencing a life-threatening event;
(b) being subject to a serious physical attack or assault including rape and sexual molestation; or
(c) being threatened with a weapon, being held captive, being kidnapped, or being tortured;

"a category 1B stressor" means one of the following severe traumatic events:

(a) being an eyewitness to a person being killed or critically injured;
(b) viewing corpses or critically injured casualties as an eyewitness;
(c) being an eyewitness to atrocities inflicted on another person or persons;
(d) killing or maiming a person; or
(e) being an eyewitness to or participating in, the clearance of critically injured casualties;

"a significant other" means a person who has a close family bond or a close personal relationship and is important or influential in one's life;

"an eyewitness" means a person who observes an incident first hand and can give direct evidence of it. This excludes a person exposed only to media coverage of the incident;

"being exposed to repeated or extreme aversive details of severe traumatic events" means witnessing a person suffering real, severe, traumatic events (for example, first responders collecting human remains, police officers repeatedly exposed to details of child abuse or drone operators viewing planned strikes) or

repeatedly listening to a person's account of their exposure to severe traumatic events. This definition includes media exposure of the traumatic event (for example, electronic media, television images or photographs) where viewing these images is a work requirement;

"death from posttraumatic stress disorder" in relation to a person includes death from a terminal event or condition that was contributed to by the person's posttraumatic stress disorder;

"DSM-5" means the American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition. Arlington, VA, American Psychiatric Association, 2013;

"ICD-10-AM code" means a number assigned to a particular kind of injury or disease in The International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM), Eighth Edition, effective date of 1 July 2013, copyrighted by the Independent Hospital Pricing Authority, and having ISBN 978-1-74128-213-9;

"relevant service" means:

(a) eligible war service (other than operational service) under the VEA;
(b) defence service (other than hazardous service and British nuclear test defence service) under the VEA; or
(c) peacetime service under the MRCA;

"severe childhood abuse" means:

(a) serious physical, emotional, psychological or sexual harm whilst a child aged under 16 years; or

(b) neglect involving a serious failure to provide the necessities for health, physical and emotional development, or wellbeing whilst a child aged under 16 years;

where such serious harm or neglect has been perpetrated by a parent, a care provider, an adult who works with or around that child, or any other adult in contact with that child;

"terminal event" means the proximate or ultimate cause of death and includes:

(a) pneumonia;
(b) respiratory failure;
(c) cardiac arrest;
(d) circulatory failure; or
(e) cessation of brain function;

"traumatic death" means death which occurs in sudden, violent or traumatic circumstances such as homicide, suicide or an accidental death.

Application

10. This Instrument applies to all matters to which section 120B of the VEA or section 339 of the MRCA applies.

Date of effect

11. This Instrument takes effect from 22 September 2014.

Dated this *twenty-second* day of *August* 2014

The Common Seal of the)
Repatriation Medical Authority)
was affixed at the direction of:)

PROFESSOR NICHOLAS SAUNDERS AO
CHAIRPERSON

Appendix 4: "Jumping Jack" by JTB. Extracted from the website of the Original Victor Company (webmaster R.N.Himona)
http://www.vcoy67.org.nz/jumping.htm

Jumping Jack

I was about 8 or 10 paces behind Morrie when he stepped on the mine. It fucks me up to talk about this and I have nightmares about it fairly frequently, yelling out a warning to him not to move but no sound comes out of my mouth - The dream always ends the same way with a brilliant explosion and me waking up screaming.

The mine was an M26 "Jumping Jack" and when it went up the warhead actually propelled itself out of the ground up to the height of his balls. Believe it or not I think that I actually saw it. It was painted deep bronze green and had yellow markings. Time stood still, there was a brilliant orange flash and I hit the deck. The vegetation was very thick and I was well protected. Not so Morrie, the mine blew the the lower half of his body to pieces. His legs were separated from the rest of him and his balls were blown up onto his webbing.

We were all terrified that we were in the middle of a minefield and were pretty shaken up. The rest the section ran up to where I was so that we could pull Morrie back. As unbelievable as it sounds he was still alive and he pulled himself up onto his arse in a sitting position. "Don't move!" he yelled "And don't come and get me ... I'm had it!"

Morrie was older than the rest rest of us and was a junior NCO. He was an excellent soldier and I looked up to him. To see him blown to pieces in front of my very eyes was hell.

Presently an Aussie Engineer who was with us yelled out to Morrie "Don't move cobber, I'm coming to get you, just hang on and don't die! " The Aussie pulled his bayonet and squatted down and started prodding into the jungle floor ... The rest of us stayed put and I kept talking to Morrie to try and keep him conscious. I felt so helpless and there wasn't a fuckin thing that I could do.

On that Op (operation) we had all been issued with morphine jabs which we wore around our

necks. As I watched Morrie pulled his ampoule, cleared the needle and jabbed himself directly into his neck. Then he quietly prayed to himself in Maori and as I watched the colour in his face drained and he slowly slumped onto his side ... He bled to death before we could reach him.

I was too young for Borneo but I had made it to the Nam. When this incident occurred I think that I was nineteen. In a dirty war this was as bad as it ever got for me ...

Kia Hunga Mate , Ki te Hunga Mate!
Kia Hunga Ora, Ki te Hunga Ora!
JTB

Published in *The Vietnam Scrapbook, The Second ANZAC Adventure*, p 205, Subritzsky, Mike, Three Feathers Publishing, Papakura, 1995.

home | honour roll | people | deployment | operations
stories | sitemap | links

BRIEF OF EVIDENCE
MAJOR (RETD) R.N.HIMONA RNZIR

Appendix 5: Extract (Phuoc Tuy Province) from HQ USAF Data Services "Herb Tapes, Defoliation Missions in South Vietnam 1965 -1971.

Legend:

- Date – expressed yy/mm/dd, e.g. 680608
- Type – "O" (Agent Orange) or "W" (Agent White)
- Gals – quantity sprayed (1,000 gallons per aircraft)
- Type – "D" = defoliant
- LEG – Start and Finish points
- UTM – Grid references of start and finish points

MISSIONS STARTING IN PHUOC TUY

PROV NO. = 27

DATE	AGN	GALS	TYP	LEG	UTM
651110	0	1500	C	1A	YS350780
651110		0		1B	YS720760
651110	0	2650	C	1A	YS350780
651110		0		1B	YS720760
651218	0	2350	D	1A	YS590613
651218		0		1B	YS530598
651218	0	3500	D	1A	YS590613
651218		0		1B	YS530598
651223	0	2000	D	1A	YS235785
651223		0		1B	YS290628
651223	0	1000	D	1A	YS230785
651223		0		1B	YS235755
651227	0	3000	D	1A	YS590610
651227		0		1B	YS530600
651227	0	3000	D	1A	YS460483
651227		0		1B	YS425566
651230	0	2000	D	1A	YS240785
651230		0		1B	YS295628
651230	0	3000	D	1A	YS430569
651230		0		1B	YS470483
660101	0	2000	D	1A	YS240780
660101		0		1B	YS290630
660101	0	2000	D	1A	YS430570
660101		0		1B	YS470480
660102	0	2000	D	1A	YS257744
660102		0		1B	YS295630
660103	0	2900	D	1A	YS600605
660103		0		2A	YS465485
660104	0	2000	D	1A	YS240780
660104		0		1B	YS290630
660118	0	2250	D	1A	YS590607
660118		0		1B	YS530595
660207	0	2000	D	1A	YS308515
660207		0		1B	YS298496
660226	0	1000	D	1A	YS308515
660226		0		1B	YS298495
660311	0	2000	D	1A	YS470500
660311		0		1B	YS460560
660314	0	2000	D	1A	YS470485
660314		0		1B	YS495515
660412	0	2000	D	1A	YS353672
660412		0		1B	YS340620
660412		0		1C	YS324623
660412		0		1D	YS302632
660412	0	2000	D	1A	YS450575
660412		0		1B	YS456557
660412		0		1C	YS481518
660412		0		1D	YS490531
660605	0	4000	D	1A	YS480520
660605		0		1B	YS440560

MISSIONS STARTING IN PHUOC TUY

PROV NO. = 27

DATE	AGN	GALS	TYP	LEG	UTM
660605		0		1C	YS450520
660607	O	4000	D	1A	YS450550
660607		0		1B	YS490520
660620	O	1600	D	1A	YS432566
660620		0		1B	YS467484
660630	O	4000	D	1A	YS465482
660630		0		1B	YS431568
660630		0		2A	YS456526
660630		0		2B	YS463539
660630		0		2C	YS475516
660802	O	1350	D	1A	YS323525
660802		0		1B	YS345560
660802	O	2000	D	1A	YS351522
660802		0		1B	YS320524
660908	O	1000	D	1A	YS320530
660908		0		1B	YS352555
661124	O	1100	C	1A	YS670590
661124		0		1B	YS610615
661129	O	3600	D	1A	YS390720
661129		0		1B	YS315767
661129		0		2A	YS365730
661129		0		2B	YS365790
661202	O	2700	D	1A	YS430790
661202		0		1B	YS380710
661202		0		1C	YS300790
661204	O	2700	C	1A	YS390850
661204		0		1B	YS890810
670113	O	1800	D	1A	YS762658
670113		0		1B	YS649584
670120	O	2700	D	1A	YS615851
670120		0		1B	YS695851
670125	W	1800	C	1A	YS616880
670125		0		1B	YS738880
670126	O	2700	C	1A	YS790660
670126		0		1B	YS650580
670126	O	1600	C	1A	YS340730
670126		0		1B	YS340790
670130	W	1800	D	1A	YS740900
670130		0		1B	YS610900
670130	O	1800	D	1A	YS630790
670130		0		1B	YS790800
670203	O	2700	D	1A	YS365730
670203		0		1B	YS365790
670205	O	1800	D	1A	YS632820
670205		0		1B	YS770820
670213	O	2700	D	1A	YS616853
670213		0		1B	YS616800
670214	O	2100	D	1A	YS570582
670214		0		1B	YS523840
670214	O	2700	D	1A	YS638740

MISSIONS STARTING IN PHUOC TUY PROV NO. = 27

****

DATE	AGN	GALS	TYP	LEG	UTM
670214		0		1B	YS798740
670214		0		2A	YS630850
670214		0		2B	YS790850
670215	O	2700	D	1A	YS717617
670215		0		1B	YS766648
670215		0		2A	YS718613
670215		0		2B	YS753617
670215		0		2C	YS771639
670216	O	1800	D	1A	YS677850
670216		0		1B	YS727820
670216		0		1C	YS857820
670218	O	2700	D	1A	YS794880
670218		0		1B	YS615880
670218	O	2400	D	1A	YS780700
670218		0		1B	YS917765
670220	O	2500	D	1A	YS633788
670220		0		1B	YS791788
670310	O	1800	D	1A	YS737898
670310		0		1B	YS616898
670310	B	900	D	1A	YS737898
670310		0		1B	YS616898
670310	B	1800	D	1A	YS820836
670310		0		1B	YS630847
670323	O	2700	D	1A	YS380850
670323		0		1B	YS380810
670323		0		2A	YS350850
670323		0		2B	YS355810
670323	W	2700	D	1A	YS380850
670323		0		1B	YS380810
670323		0		2A	YS350850
670323		0		2B	YS355810
670323	O	5100	D	1A	YS330790
670323		0		1B	YS390790
670323		0		2A	YS346805
670323		0		2B	YS390805
670328	O	2790	D	1A	YS820810
670328		0		1B	YS630810
670331	O	2790	D	1A	YS751665
670331		0		1B	YS926747
670401	O	2790	D	1A	YS520840
670401		0		1B	YS580840
670401		0		2A	YS520850
670401		0		2B	YS580850
670404	O	2790	D	1A	YS520810
670404		0		1B	YS580810
670404		0		2A	YS520830
670404		0		2B	YS580830
670408	O	2790	D	1A	YS580820
670408		0		1B	YS520820
670821	O	2000	D	1A	YS800822

MISSIONS STARTING IN PHUOC TUY
****

PROV NO. = 27

DATE	AGN	GALS	TYP	LEG	UTM
670821		0		1B	YS633849
670821	W	5000	D	1A	YS800822
670821		0		1B	YS633849
670822	O	3000	D	1A	YS800834
670822		0		1B	YS640838
670823	O	3000	D	1A	YS806752
670823		0		1B	YS633752
670824	W	3000	D	1A	YS805800
670824		0		1B	YS670798
670824	O	1000	D	1A	YS805800
670824		0		1B	YS670798
670902	W	1850	D	1A	YS805779
670902		0		1B	YS633779
670912	O	3000	D	1A	YS816748
670912		0		1B	YS633748
670925	O	2950	D	1A	YS790759
670925		0		1B	YS615759
670926	O	5700	D	1A	YS363660
670926		0		1B	YS363840
670927	W	5700	D	1A	YS585870
670927		0		1B	YS585800
670929	O	2725	D	1A	YS800823
670929		0		1B	YS863823
671002	O	3000	D	1A	YS796747
671002		0		1B	YS634747
671026	O	4850	D	1A	YS803808
671026		0		1B	YS632807
671030	W	3400	D	1A	YS287710
671030		0		1B	YS287780
680109	W	4400	D	1A	YS270732
680109		0		1B	YS285733
680109		0		1C	YS339813
680109		0		2A	YS294730
680109		0		2B	YS310730
680109		0		3A	YS325754
680109		0		3B	YS326794
680110	W	5950	D	1A	YS575896
680110		0		1B	YS575800
680112	W	6000	D	1A	YS595898
680112		0		1B	YS595800
680112	W	3000	D	1A	YS475504
680112		0		1B	YS433571
680128	O	4000	D	1A	YS813692
680128		0		1B	YS752616
680128		0		1C	YS678590
680128	O	3000	D	1A	YS800785
680128		0		1B	YS632786
680128	W	4000	D	1A	YS800785
680128		0		1B	YS632786
680129	W	4000	D	1A	YS480508

MISSIONS STARTING IN PHUOC TUY

PROV NO. = 27

****

DATE	AGN	GALS	TYP	LEG	UTM
680129		0		1B	YS440572
680317	W	6000	D	1A	YS605886
680317		0		1B	YS605800
680320	W	6000	D	1A	YS252778
680320		0		1B	YS252857
680320		0		1C	YS232838
680320		0		1D	YS304898
680322	W	3600	D	1A	YS288780
680322		0		1B	YS286870
680322		0		1C	YS330904
680331	W	6000	D	1A	YS800827
680331		0		1B	YS232823
680406	O	3000	D	1A	YS272690
680406		0		1B	YS272775
680413	W	3000	D	1A	YS744628
680413		0		1B	YS561595
680413	W	2300	D	1A	YS614890
680413		0		1B	YS614800
680422	O	5650	D	1A	YS756618
680422		0		1B	YS710616
680422		0		2A	YS677587
680422		0		2B	YS598583
680430	W	5000	D	1A	YS810742
680430		0		1B	YS004505
680506	W	6000	D	1A	YS790685
680506		0		1B	YS633620
680512	W	3000	D	1A	YS180755
680512		0		1B	XS998755
680513	O	5000	D	1A	YS780882
680513		0		1B	YS615882
680516	W	2750	D	1A	YS752852
680516		0		1B	YS605852
680513	W	2800	D	1A	YS610892
680518		0		1B	YS619898
680521	W	6000	D	1A	YS755683
680521		0		1B	YS591598
680526	W	6000	D	1A	YS626900
680526		0		1B	YS626800
680526		0		2A	YS637800
680526		0		2B	YS637870
680527	W	3000	D	1A	YS633800
680527		0		1B	YS638873
680527		0		2A	YS623900
680527		0		2B	YS623800
680528	W	6000	D	1A	YS357664
680528		0		1B	YS357830
680530	W	2000	D	1A	YS811698
680530		0		1B	YS750627
680608	O	3000	D	1A	YS301706
680608		0		1B	YS301870

MISSIONS STARTING IN PHUOC TUY
****

PROV NO. = 27

DATE	AGN	GALS	TYP	LEG	UTM
680613	O	3000	D	1A	YS780680
680613		0		1B	YS640628
680618	O	5000	D	1A	YS611588
680618		0		1B	YS690619
680620	W	6000	D	1A	YS282687
680620		0		1B	YS282774
680620		0		2A	YS278687
680620		0		2B	YS278774
680620	W	5000	D	1A	YS333675
680620		0		1B	YS330855
680623	W	5000	D	1A	YS352651
680623		0		1B	YS352802
680624	W	2900	D	1A	YS756635
680624		0		1B	YS601596
680625	O	5675	D	1A	YS312628
680625		0		1B	YS274688
680625		0		1C	YS274744
680627	W	6000	D	1A	YS349680
680627		0		1B	YS342836
680630	W	4500	D	1A	YS750625
680630		0		1B	YS703623
680630		0		2A	YS678592
680630		0		2B	YS640591

Appendix 6: 1 ATF Commanders Diary January 1968, Duty Officers Log for 8 January 1968.

SECRET

LOG SHEET
G (Ops) HQ 1 ATF

Sheet No 105 Date 8 Jan 68

Serial	Time	To or From	Event	Action	Initials
1271	1100H	F/ 9 Div (LATE LOG)	Request approval for defoliation from 090930H to 091100H in area: YS3383-YS3379, YS3484-YS3379. YS328780; YS320755; YS312740; YS300730; YS335780; YS329785; YS320740; YS320730.	Approved, clearance given to return fire for fire. G2(Air) info.	
1272	1415H	T/ Arty	Reference Fire Plan PLUTO DARLING LORRAINE Serials 1 to 14 except serial 8 clear ground 1 ATF.	Arty info. Serial 8 deleted.	
1273	1430H	F/ G2(Air)	Traildust 9 Jan 68. Tgt 1. 090930H to 091100H. YS3383-YS3379 YS3484-YS3379 YS328780-YS320755 YS312740 - YS300730 YS335780- YS329785 YS320740-YS320730. Tgt 2. TOT from 091000H. YS3178-YS3377-YS2774- YS3174-YS3275- YS3380-YS3481.		
1274	1445H	F/ HORSESHOE	LOCSTAT: Ptl 7E YS508616.	Arty info.	
1275	1500H	F/ 2 RAR	LOCSTATS: V Coy 1 Pl YS397727. 2 Pl no change. Ptl 52A YS377677.	Arty info.	
1276	1505H	F/ 7 RAR	LOCSTAT: 9 Pl YS460685.	Arty info.	
1277	1520H	F/ HORSESHOE	Ptl 7E returned to HORSESHOE.	Arty info.	
1278	1537H	F/2 RAR	LOCSTAT: V Coy 1 Pl YS397730.	Arty info.	
1279	1540H	F/161 Recce	VR Report. Mission time 1330-1500. 10 rice mats at YS588884 YS590884. Oxcart tracks at YS590890. Rice being harvested at YS578871. Progress on garden cultivation at YS598827.	Arty info.	
1280	1550H	F/2 RAR	HORSESHOE convoy is now at NUI DAT.	Arty info.	
1281	1410H	F/ALO	LATE LOG. Airstrike. 1. TOT 1410-1418. 2. YS577826. 3. 80/20 30 metres uncovered, 2 fighting positions destroyed. 3 F100 WARHAWK 61, number 1528, 8 M82, 4 M117, VC Base Camp.	G Air info.	
1282	1555H	F/HORSESHOE	LOCSTAT: W Coy 1 Pl YS509584.	Arty info.	

SECRET

Appendix 7: "Operation FLYSWATTER: A War Within a War", Cecil & Young, 2007.

EXHIBIT A

Commentaries

Operation FLYSWATTER: A War Within a War

Paul F. Cecil, Sr.[1] and Alvin L. Young[2]*

[1] Historian and Archivist, The RANCH HAND Vietnam Association, Hurricane, Utah, USA
[2] Institute for Science and Public Policy, Sarkeys Energy Center, The University of Oklahoma, Norman, Oklahoma, USA

* Corresponding author

DOI: http://dx.doi.org/10.1065/espr2007.12.467

Preamble

Despite extensive experience with mosquito-borne diseases affecting combat capability of the Armed Forces during World War II and Korea, in 1965 the United States military was unprepared to deal with the *Anopheles* mosquito in the highlands of South Vietnam and the subsequent malarial casualties. Regardless of the weekly use of prophylactic measures, up to 50 percent of American soldiers initially involved in combat operations in the heavily forested regions of South Vietnam developed malaria. Not until nearly two years after the introduction of American ground troops into the Southeast Asian conflict did the Department of Defense authorize the extensive insecticide aerial spraying necessary to protect both Allied and indigenous forces. Even then, military leadership failed to take advantage of much of the knowledge and experience of an existing stateside unit specifically tasked in aerial spraying and mosquito control.

This commentary reviews the events and supporting historical information related to the fixed-wing aerial spraying of insecticides from October 1966 to December 1971 during the Vietnam War. The historical information was divided into two categories; the need for critical information assessing the spread and impact of malaria among military and civilian personnel, and the operational information essential for combating the mosquitoes that were the carriers of malaria. Using modified UC-123 transport planes to spray malathion insecticide, Operation FLYSWATTER was the eventual fixed-wing, large-area answer to the biting insect. Unlike the short time-on-target of the defoliation missions, the insecticide spray aircraft's treetop level flights lasted for as much as two very hazardous hours of flying. So successful were these missions in controlling mosquitoes that preventative medicine requests ultimately resulted in 14 major allied military bases and their adjoining Vietnamese cities being sprayed routinely every 9 days, weather permitting. The 'mosquito war' required over 1,300 individual missions and dispensed approximately 1.76 million liters of malathion concentrate. Operation FLYSWATTER was a significant part of the overall United States' preventative medicine program to reduce the number of man-days lost to ground forces due to malaria. Ironically, although the program was widely publicized through both military and civilian in-country channels, the memories of many veterans of the Vietnam War would later confuse exposure to the insecticide spray missions with the spraying of the Agent Orange defoliant in Vietnam.

Please cite this paper as: Cecil PF Sr., Young AL (2007): Operation FLYSWATTER: A War Within a War. Env Sci Pollut Res 15 (1) 3–7

1 Introduction

Malaria, spread by mosquitoes, has been influencing military campaigns in Southeast Asia since Kubula Khan [1]. During World War II Allied forces in the Pacific theater suffered more casualties from this disease than from enemy action, and solving this problem became a major objective of Allied commanders. Despite this historical experience, during the first two years of combat-force involvement in South Vietnam, more than 10,000 Americans were rendered casualties by this bothersome insect and the rediscovery of an operational solution was not implemented until 1967. To combat the impact of malaria among military personnel, the United States Military Assistance Command, Vietnam (MACV) ultimately authorized Operation FLYSWATTER, using 7th Air Force 'RANCH HAND' UC-123 defoliation aircraft modified to an insecticide configuration. Little has been published on the history of this Operation, and as a consequence there exists much confusion in the civilian and Vietnam veteran communities as to the use of RANCH HAND aircraft for this mission.

2 Background

The Vietnamese phrase for malaria is ***sat ret rung***, which literally means 'jungle fever'. The principal malarious region of South Vietnam was the central highlands where the malaria parasitic species encountered were *Plasmodium falciparum*, *P. vivax*, and some *P. malariae*. *P. vivex* predominated in the Coastal Plains and Delta Region. Unfortunately, the most serious malaria, *falciparum*, was also most prevalent, accounting for 50–75% of cases in the US Army in Vietnam. Although both falciparum malaria cases and the abundance of *Anopheles* mosquitoes increased with the summer monsoon season, neither disappeared in tropical Vietnam as they did in winter in the temperate zones. Furthermore transfers of parasite reservoirs from hyperendemic, independent malaria foci to all parts of Vietnam became increasingly obvious in 1966 as Montagnard and Vietnamese refugees and military personnel moved from one area to another [2,3].

The deployment of major US combat forces into South Vietnam found them unprepared for the disease-ridden conditions. Despite the weekly use of prophylactic choroquine-primaquine pills, 5 to 50% of American soldiers coming off early field actions in the heavily forested regions of South Vietnam would develop malaria [4]. By December 1965, the overall Army admission rate for hospitalization was 98.4 admissions per thousand per year, nearly rivaling some Pacific theater rates of World War II. Indeed, some units operating in the Ia Drang

Valley had rates as high as 600/thousand/year. Two of the first infantry battalions sent into the Central Highlands "were rendered ineffective" as a result of losses due to malaria [5].

Compounding the threat to Allied troops in South Vietnam was the discovery of chloroquine-resistant *Plasmodium falciparum* infections in 1965, when up to 80% of cases failed to be cured by standard chloroquine therapy [3,6]. A highly effective new regimen using quinine, pyrimethamine, and dapsone was adopted by the US Army, but at the risk of some complications and side effects. From 1965 to 1969, more than two of every three US Army hospital admissions in Vietnam were as a result of disease, mainly malaria. During the same period, battle injuries accounted for only one of six admissions. Equally important was the problem of introduction of malarial parasites into local *Anopheles* mosquitoes by veterans of the various Allied nations on their return from Vietnam. Unlike previous wars, the rapid repatriation home of veterans by air transport interfered with the requirement for the full eight weeks of chemoprophylaxis, especially for the long latency *P. vivax*. Malaria would be the greatest medical problem imported to the Continental United States by Vietnam veterans [3,6].

Ironically, the enemy in Vietnam was both a major contributor to and a target of the same malarial infections that plagued the Allied forces. Interrogations of prisoners and review of captured documents indicated that the most serious problem faced by infiltrating North Vietnamese soldiers was malaria [7]. Unit incident rates as high as 50% were reported, with the most serious cases left behind at rest stops along the way, or even returned north; however, most disease-stricken infiltrators were forced to stay with their group, albeit at the cost of lowered morale and delayed movement. Even groups fortunate enough to be accompanied by medical corpsmen frequently faced a shortage of medical supplies to treat the various diseases [8,9]. The resultant high infection rates among enemy personnel, in conjunction with rates of 50–75% among chronically infected indigenous personnel, provided a ready reservoir for the mosquito population to feed on [7]. Obviously combat contact in enemy-held areas exposed Allied forces to regions where little or no preventive medicine had taken place.

As a 1965 Preventive Medicine Orientation to Vietnam pamphlet stated, there was "a foolproof method of avoiding malaria in Vietnam: don't get bitten by *Anopheles* mosquitoes" [3]. As desirable as this solution was, it was equally unlikely. Obviously, in addition to identification and treatment of the disease came eradication of the parasite carrier. But enemy activity made use of traditional ground-based equipment and processes hazardous except in secure areas, while the publication of Rachal Carson's *Silent Spring* made the widespread use of dichlorodipbenyltrichloroethane (DDT) unacceptable. In 1966, both the Army and Navy were experimenting with low volume dispersal of malathion insecticide via helicopter. The Navy used a "Helicopter Insecticide Dispersal Apparatus, Liquid" (HIDAL) that had to be semi-permanently mounted on a Marine Corps UH-34 helicopter [10]. The Army trials involved a commercially designed system that could quickly be mounted on Bell UH-1D helicopters without modification of the aircraft [11,12].

The principal drawbacks to both the Army and Navy programs were the helicopter's high vulnerability to ground fire at the altitude from which the chemical had to be applied, and the limited amount of chemical that could be carried. The Standard Agricultural Aviation System for UH-1 helicopters had a 760-liter herbicide supply tank and a 14-meter spray boom, but the UH-1 could only lift off with a maximum of 570 liters in the tank, resulting in limited short flights. Furthermore, the 15-meter flight altitude to achieve an effective spray swath of 45 meters was almost suicidal over enemy-controlled areas [13]. Both services had asked for the use of a larger conventional aircraft, such as the C-123B 'Provider,' to conduct spray tests; although Preventive Medicine personnel were generally skeptical of the transport's potential for useful results. This concern was contrary to the experience that the United States Air Force (USAF) had accrued through the Special Aerial Spray Flight (SASF) at Tactical Air Command Headquarters, Langley Air Force Base (AFB), Virginia [14]. This unit represented the culmination of airborne pest spray knowledge dating from the events of World War II's Pacific theater, the Korean War, and numerous national emergency situations in the interwar periods. SASF also was experienced in spraying stateside military bases and maneuver areas [15]. By 1965, SASF had three C-123's modified for liquid spray dispersal, but these aircraft were not deployed to Vietnam. Instead these aircraft were available worldwide for pest control projects. In Vietnam the difficulty was that the demands for combat operations for the limited numbers of C-123s apparently took precedence over "slapping mosquitoes" in the minds of military leadership [16].

3 RANCH HAND Gets an Added Mission

It was not until October 1966 that USAF Headquarters, at the insistence of the Commander of US Forces in Vietnam, decided it could spare one of the RANCH HAND UC-123 defoliation aircraft to be reconfigured to spray the insecticide malathion as part of a test program to reduce mosquitoes in South Vietnam. The test program, however, required 'bite' and 'count' tests by individuals located on the ground at night with flashlights in the sprayed areas, not a desirable assignment in wartime South Vietnam, so the trials were relocated to a test area in Thailand [17]. On 14 October 1966, a RANCH HAND aircraft, thoroughly cleaned of herbicide residues and equipped with the finer orifice nozzles needed for insecticide dispersal, left Saigon for Bangkok, Thailand.

Unfortunately, when the test aircraft arrived in Bangkok, it was discovered that an unusually dry season in the test area had reduced the mosquito breeding areas to the point that the population was too low for meaningful evaluation. After several days in Thailand, the evaluation team returned to South Vietnam to conduct limited tests. Although reduction of the mosquito population would benefit the Viet Cong as well as Allied forces, the test aircraft would occasionally encounter ground fire. During one flight over a wide river valley the aircraft received ground fire and a 'hit' in the insecticide supply tank. The crew elected to 'emergency dump' the entire remaining load of insecticide and return to base [15,18]. In all fairness to the crew, they obviously felt 'naked' without the multiple spray aircraft and the Forward Air Controller (FAC) and fighter escorts that normally accompanied the planes on herbicide targets.

Despite continuing high casualty rates due to malaria, the test eradication program was terminated and nothing more occurred until early 1967. RANCH HAND, now a full-sized separate USAF squadron, the 12th Air Commando Squadron (12th ACS), again was tasked to clean and prepare one of their UC-123 aircraft for in-country tests. As before, the 'decision makers' were ignoring and duplicating nearly 20 years of experience in spray operations and mosquito control programs already accumulated by the Special Aerial Spray Flight in the United States. After the initial development stages of the herbicide spray concept, SASF's only role in the Vietnam program had been to provide hands-on spray training at Langley to aircrews selected for RANCH HAND assignment. The "reinvention-of-the-wheel" syndrome had once more become the delaying force behind a needed program [16]. Again because of the obvious danger to observers spending the night in Vietnamese jungles counting mosquitoes, the new trials were conducted over Con Son Island, a secure island off the Mekong delta.

Following successful Con Son trials, the 12th Air Commando Squadron was ordered to modify and permanently assign one of its eighteen UC-123s to fulltime pesticide duty under the control of the MACV Surgeon General's Office [19]. Codenamed Operation FLYSWATTER, the UC-123 aircraft was the ideal vehicle for wide-area pesticide spraying. Insect control had become an added task for the herbicide spray squadron. Malathion storage and servicing were made available at three locations in Vietnam: Bien Hoa Air Base, Cam Ranh Bay Air Base, and Da Nang Air Base. Responsible units were the Army's 20th Preventive Medicine Unit, the Army's 105th Medical Detachment, and the Navy's Preventive Medicine Unit, respectively. The Navy unit was later replaced by the Army's 172nd Preventive Medicine Unit. Overall control by the MACV Surgeon General was exercised thru the Army's 67th Medical Group and 44th Medical Brigade [3].

4 Modification of the UC-123

To distinguish what became popularly known as the 'Bug Bird' from the herbicide-spraying aircraft of the squadron, the selected UC-123 was stripped of its camouflage paint and coated with an alodine compound to guard against the insecticide's corrosive effects (**Fig. 1**) [20]. It was hoped that enemy troops would recognize the benefits provided by the aluminum-colored UC-123's anti-mosquito mission and therefore not attempt to shoot down the unarmed and unarmored obsolete transport, as they did the camouflaged planes spraying herbicides. Other modifications included opening the ram air scoop and venting the chemical tank to the heater exhaust to aid in the removal of the strong malathion fumes from the interior of the aircraft; removing the unneeded tail spray boom; and installing an electric motor-driven pump to flush the windshield and thus remove the spray which accumulated on the windshield during repeated spray runs. An additional benefit of the tail boom removal was that the 10-cm tail boom supply line could now serve as an alternate method of dumping the chemical in an emergency. The spray booms that were mounted under each wing were fitted with 32 Teejet® nozzles that produced a median spray droplet of less than 50 microns [21,22].

Fig. 1: RANCH HAND UC-123 'Silver Bug Bird' of Operation FLYSWATTER at Bien Hoa Air Base, Vietnam, 1968

The first Bug Bird was 'Little Devil' (serial number 56-4396). 'Little Devil' was soon replaced by 'Patches' (serial number 56-4362). 'Patches' was one of the first three aircraft that originally entered South Vietnam in 1961 and got its name from the numerous hits received from ground fire and the many metal patches subsequently applied over the damaged skin areas. By 1967 the plane had taken well over 500 'hits' during herbicide missions. It had also become the first and only C-123 to fly completely around the world when, in 1962, it returned to the United States by way of Afghanistan and Iran where it assisted in their fight against a plague of locusts. When once again assigned to Vietnam, the aircraft became a sentimental (and perhaps superstitious) favorite of the unit and the airmen hoped to avoid losing the venerable 'Old Lady' by assigning her to the safer Bug Bird duty [16].

5 Control with the Insecticide Malathion

Malathion initially was scheduled to be dispensed over nine different major US bases and their adjoining cities in South Vietnam on a regular basis of every 11–14 days [23]. Ideal time for spraying was the 1½ hr immediately after dawn and the 1½ hr just before sunset, when the mosquitoes were most active. The insecticide was most effective against the insects when in flight, rather than as larvae. Malathion was applied at the rate of 0.59 liters/hectare of a 57% concentrate, and spray restrictions were the same as for herbicide application, i.e., maximum winds of 10 knots, maximum temperature of 30° C, and no rainfall during or for one hour after spraying [11]. Spraying was conducted at a maximum of 45 meters above the terrain and at an air speed of 130 knots. The low rate of application enabled one insecticide sortie to cover about 6,000 hectares [20].

The first operational malathion mission was flown on 6 March 1967. The mosquito suppression task represented a radical change for the RANCH HAND aircrews. Herbicide missions had to be flown with multiple spray planes (two to twelve) accompanied by a Forward Air Controller (FAC) and fighter escorts. To protect the herbicide aircraft, MACV directives required target areas to be completely free of all friendly ground forces and to be authorized as 'free fire' areas for the accompanying fighter escorts [23]. Unlike the herbicide missions, the single insecticide aircraft was not supported by either FAC or by fighter escort during the low-level flights that lasted for as much as two hours (low-level exposure during herbicide mis-

sions seldom totaled more than 10 min). Mosquito missions were usually preceded by psywar leaflet drops several days ahead of time describing the benefits of the mission to the communities, and asking the people not to fire at the silver aircraft. On the day of the mission a U-10 Helio-Courier 'speaker' aircraft from the 5th or 9th Air Commando Squadrons often accompanied the insecticide aircraft, circling overhead and broadcasting that the malathion was for their own good and that it posed no threat to people, animals, or crops [24,25].

The effectiveness of these precautions was reflected in the very low number of hits taken by the bug birds. Only rarely during the four years of operation did the insecticide crews receive ground fire, and then usually when spraying long-held enemy base-camp areas before major Allied ground assaults. Vietnamese farmers and plantation owners frequently took advantage of a government compensation program for accidental herbicide damage to crops by claiming that drought- or insect-caused injury was the result of spraying by "the big silver plane" [26]. Years later, when the Agent Orange controversy arose, numerous veterans of the Vietnam conflict also would mistakenly credit the insecticide aircraft as having sprayed them with "Agent Orange" [23].

During the remaining months of 1967 the 'bug bird' averaged 18.3 sorties per month. Total malathion dispensed in 1967 was 451,872 liters, with an average of 2,470 liters per sortie [25]. Manning the aircraft were volunteers from among the herbicide crews; insecticide duty broke the normal RANCH HAND routine since the crews landed at various bases with frequent overnight stays throughout South Vietnam. Volunteers had to be experienced and fully qualified in all phases of low-level operations since the insecticide missions could last as long as 2 hr of hazardous tree-top flying [16].

In addition to routine scheduled malathion applications to the approved base/city list, other insecticide targets originated at the local level where a malaria problem was present. Requests were sent to the Office of the MACV Surgeon General for approval. Approved targets went to the Tactical Air Control Center (TACC) for their coordination and returned to the MACV Surgeon General's office. MACV then forwarded the request to the 12th Air Commando Squadron where the Insecticide Flight Commander and sortie navigator planned and scheduled the target. A 'Priority One' target could be sprayed within 24 hours after the squadron was notified. Normally a target was sprayed within one week after the request was first submitted. Insecticide targets were 'group fragged' by the TACC since they didn't require the target areas to be clear of friendly forces like the herbicide missions did [18,24]. This was another reason for veterans in the future to believe they had been sprayed with dioxin-contaminated Agent Orange during combat field operations [23].

Insecticide sorties increased in 1968 from 180 to 230, as the insecticide project proved to be a successful part of the overall preventive medicine program in Vietnam. Although the total number of exposed US Army personnel increased, the number of man-days lost from duty due to malaria fell by 10%. In 1969 a second unpainted UC-123 was added to the insecticide mission and a total of 14 bases and adjacent cities were sprayed every nine days, weather permitting [23]. The insecticide unit was now a separate flight of the 12th squadron under command of a major. Many of the replacements to RANCH HAND were newly graduated or inexperienced lieutenants with less than 400 hours flying time and no previous experience in other than high altitude jet aircraft. To give these pilots additional conventional and low-level navigation experience under at least semi-safe conditions RANCH HAND assigned them to copilot duties on the 'Bug Birds.' Experienced theater-qualified pilots were assigned for 30-day tours as the aircraft commanders. The 'good weather' quarter of April-June 1969 saw an insecticide record of 135 sorties spraying 165,000 liters of malathion. However the year-end totals were only 295 sorties and 378,860 liters.

While the herbicide mission prepared for phase out in early 1970 due to adverse publicity and international protest, the insecticide flight was busier than ever. From 80 sorties spraying 94,075 liters of malathion in the first quarter, requirements jumped to 110 sorties and 123,920 liters in the April-June quarter. The 'Bug Birds' were also tasked with something new in May 1970. Using both aircraft, 7th Air Force decided to try insecticide spraying a 'high threat' area of active combat at Landing Zone Baldy and Fire Base Ross in I Corps approximately 32 km south of Da Nang. The spray planes would be supported by Army helicopter gunships and 1st Marine Air Wing fighters. Psywar activities would be used to notify the enemy that the target was mosquitoes, a benefit to both sides. After arriving in Da Nang on 20 May to make final preparations, one of the 'Bug Birds' flew an unopposed survey flight over Landing Zone Baldy on the morning of 21 May. Unfortunately, the following morning, the aircraft encountered intense ground fire and were forced to abort the mission. At 7th Air Force's direction the two UC-123s attempted to spray Fire Support Base Ross on 29 May. Again heavy ground fire drove the mission off target. Although the eleven hits on the spray planes had caused no major structural damage or personnel casualties, further attempts to spray high threat areas were abandoned and the 'Bug Birds' returned to their more routine duties.

6 Termination of the Program

In July 1970 the RANCH HAND squadron was deactivated and the remaining spray planes became 'A' Flight of the 310th Tactical Airlift Squadron, based at Phan Rang Air Base. This presented problems for the insecticide planes because Phan Rang had no insecticide re-servicing capability, forcing the planes to fly extra sorties to load malathion from the stocks at Bien Hoa, Cam Ranh Bay, or Da Nang. Other changes took place in July when the Army's 172 Preventive Medicine Unit assumed responsibility for malathion operations at Da Nang and when the spray nozzles on the insecticide planes were changed to allow a finer spray of a 95% insecticide concentration to be dispensed in place of the original 57% solution. In spite of the changes and distractions, the 'Bug Birds' flew a record 146 productive sorties dispensing 85,085 liters of malathion during the quarter. For the year the totals were 486 sorties and 387,735 liters, respectively.

With the withdrawal of United States' combat forces from South Vietnam Operation FLYSWATTER was terminated in December 1971. The 'mosquito war' flew over 1,300 individual missions and dispensed more than 1.76 million liters of

malathion concentrate, about one-half the total insecticide dispensed by all forces during the conflict [23]. The mosquito control program had significantly contributed to the reduction of US Army man-days lost due to malaria from 228,000 in 1965 to 168,000 in 1970 despite the huge manpower increase during the same period [5]. Most of the aircraft and ground equipments assets were turned over to the South Vietnamese Air Force as part of the 'Vietnamization' program. 'Patches' returned to the United States and eventually was retired to the USAF Air Museum at Wright-Patterson AFB. Ohio. The venerable 'old Lady' of the spray squadron was forced to remain in 'outside' display for several years due to the reeking smell of malathion, despite a number of unsuccessful attempts to 'deodorize' the aircraft. Not until 2005 was the former Bug Bird finally moved to honorable retirement in an inside display scenario, a memorial to war against one of mankind's oldest and most persistent enemies, the mosquito.

NOTE. On 9 September 2005, three specially-equipped C-130 transports of the 910th Airlift Wing, Aerial Spray Flight, from Youngstown, Ohio, were deployed to help control mosquito infestations in the Gulf Coast disaster areas of Louisiana and Texas following Hurricanes Katrina and Rita. Flying low-level missions across the stricken areas, the men of the US Air Force once again had been called to assist in the continuing war with disease-carrying insects, renewing the traditional efforts of the Langley Special Aerial Spray Flight and Operation FLYSWATTER in Vietnam [27].

Acknowledgement. We thank the officers and men of former Operations RANCH HAND and FLYSWATTER for their cooperation and willingness to dredge up old memories, both good and bad, of events in a foreign country more than forty years ago. We also want to thank the personnel of the Air Force Historical Research Agency, Maxwell Air Force Base, Alabama, and, in particular, Ms. Anne O'Conner, for assistance in locating the official records and reports of a little-known part of American involvement in Southeast Asia.

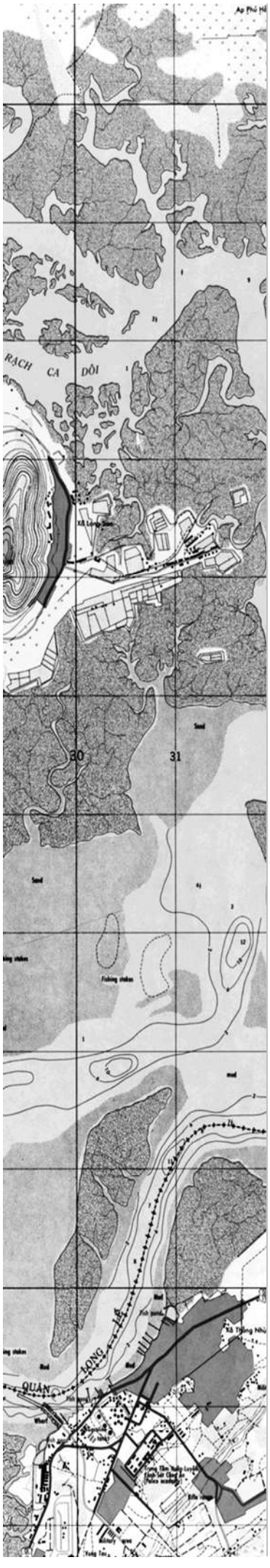
References

Except as otherwise noted, the information for this commentary was obtained from the historical records of the Special Aerial Spray Flight (SASF), 309th Air Transport Squadron (later, Air Commando Squadron); 12th Air Commando Squadron (later, 12th Special Operations Squadron); and SASF, 310th Special Operations Squadron (later, 310th Tactical Airlift Squadron); October 1965 thru December 1971, in annexes to Department of the Air Force, History of the 315th Air Commando Wing (later, 315th Special Operations Wing and 315th Tactical Airlift Wing), K-WG-315-HI, Quarterly Reports, Air Force Historical Research Center, Maxwell Air Force Base, Alabama, USA.

[1] Shanks D, Karwacki JJ (1991): Malaria as a Military Factor in Southeast Asia. Military Medicine 156 (12) 684–686
[2] Canfield CJ (1972): Malaria in US Military personnel, 1965–1971. Proceed Helminth Soc Wash 39, Special Issue: 15–18, Armed Forces Pest Management Board Library, Accession # 78589
[3] US Army 44th Medical Brigade (1970): Vietnam Preventive Medicine Orientation. Manual GR 70-200-1-1, Department of Preventive Medicine, US Army Medical Field Service School, US Army, Vietnam, US Military Assistance Command, Vietnam, Armed Forces Pest Management Board Library, Accession # 44566
[4] Kiel FW (1968): Malaria in Vietnam. Pathology Annual 3, 1–27
[5] Anonymous (1973): The Future of Military Medicine. Medical World News, Mar 30, 1973, pp 26–31
[6] Fisher GU, Gordon MP, Lobel HO, Runcik K (1970): Malaria in Soldiers Returning from Vietnam: Epidemiologic, Therapeutic, and Clinical Studies. Am J Trop Med Hyg 19 (1) 27–39
[7] Bridges JR (1973): A study of malaria rates in the Que Son Mountains of Vietnam. Military Medicine 138 (7) 413–417
[8] Cottingham AJ Jr., Boone SC, Legters LJ (1967): A Prospective Study of Malaria Incidence Among Indigenous and US Forces During Combat Operations. US Army Medical Research Team, Walter Reed Army Institute of Research, Annual Report 1 Sep 66–31 Aug 67, Washington, DC, USA, Armed Forces Pest Management Board, Accession # 39983
[9] Rogers RN, Webb CR, Adams RE (1968): Malaria Prevalence and Chloroquine sensitivity studies in North Vietnamese Army and Viet-Cong Prisoners of War at Pleiku, II Corps Tactical Zone, Republic of Vietnam. US Army Medical Research Team, Walter Reed Army Institute of Research, Annual Report 1 Sep 67–30 Jun 68, Armed Forces Pest Management Board Library, Accession # 44413
[10] Grothaus RH (1971): Insecticide Dispersal Equipment for Navy and Marine Corps Aircraft. Naval Medical Field Research Laboratory, Bureau of Medicine and Surgery, Department of the Navy, Washington DC, USA, Armed Forces Pest Management Board Library, Accession # 57625
[11] Phillips RJ (1964): Field Testing of Insecticides and Equipment (Okinawa). Report 4336N2-63/64, US Army Environmental Hygiene Agency, Edgewood Arsenal MD, USA, Armed Forces Pest Management Board Library, Accession # 21602
[12] Department of the Army (19690: Operator's and Organizational Maintenance Manual, Sprayer, Herbicide, Helicopter Mounted. Technical Manual TM5-3740-210-12, Headquarters, Department of the Army, Washington DC, USA
[13] USMACV (1968): Herbicide Program Seminar. US Military Assistance Command, Vietnam, 28 Jan 68, p 34, US Army Military History Vietnam Files, Carlisle PA, USA
[14] Dowell FH (1965): An Examination of United States Air Force Aerial Spray Operations. Mosquito News 25 (2) 209–216
[15] Adams CT, Sr. (1963): The Special Aerial Spray Flight. Report of the Thirty-fourth Annual Meeting, Florida Anti-Mosquito Association, Jacksonville, FL, USA, pp 45–48, Armed Forces Pest Management Board Library, Accession # 21148
[16] Cecil PF Sr. (1986): Herbicidal Warfare: The RANCH HAND Project in Vietnam. Praeger Special Studies, Praeger Scientific, New York NY, USA
[17] Holway RT, Morrill AW, Santana FJ. 1967. Mosquito Control Activities of the US Armed Forces in the Republic of Vietnam. Mosquito News 27 (3) 297–307
[18] Marshall C (1981): Oral History Interview. Item # 2520409012, RANCH HAND Collection, Vietnam Archives, Texas Tech University, Lubbock TX, USA
[19] Young WW (1969): C-123 Aerial Mosquito Control Program. Letter from HQ, 20th Preventive Medicine Unit, Department of The Army, Washington DC, USA, Armed Forces Pest Management Board Library, Accession # 53985
[20] Buckingham WA Jr. (1982): OPERATION RANCH HAND: The Air Force and Herbicides in Southeast Asia, 1961–1971. Office of Air Force History, United States Air Force, Washington DC, USA
[21] Baer DM (1963): Evaluation of C-123 Aircraft Spray System. Report to the 6570th Epidemiological Laboratory, Aerospace Medical Division, Air Force Systems Command, United States Air Force, Lackland Air Force Base, TX, USA, Armed Forces Pest Management Board Library, Accession # 11083
[22] Mount GA, Lofgren CS, Pierce NW, Baldwin HR, Adams CT (1970): Droplet Size, Density, Distribution and Effectiveness in Ultra-low Volume Aerial Sprays Dispersed with Teeject® Nozzles. Mosquito News 30 (4) 589–599
[23] Young AL, Cecil PF Sr., Guilmartin JF Jr. (2004): Assessing Possible Exposures of Ground Troops to Agent Orange During the Vietnam War: the Use of Contemporary Military Records. Env Sci Pollut Res 11 (6) 349–358
[24] Biery TL, Basio RG (1973): Distribution and Abundance of Mosquitoes on USAF Installations in the Republic of South Vietnam During 1970, 1971, and 1972. Report 1MSW-ENT-73-86, Headquarters, First Medical Service Wing (PACAF), APO San Francisco, CA, USA, Armed Forces Pest Management Board Library, Accession # 79289
[25] HQ MACV (1970): Medical Service Aerial Dispersal of Insecticides. Directive Number 40-10, 31 March 1970. Military Assistance Command, Vietnam
[26] Darrow RA, Bunker RC, Frank JR (1969): Report of Trip to Republic of Vietnam, 15 Aug–2 Sep 1969. Submitted 23 Sep 1969, Department of the Army, Fort Detrick, Frederick, MD, USA, Available from the Alvin L. Young Special Collection on Agent Orange, Accession # 00207, National Agricultural Library, Beltsville, MD, USA
[27] Breidenbaugh M, Haagsma K, Olson S, Teig D, Spears, B, McHugh C, Walker W, Sanders D (2006): Air Force Aerial Spray Operations to Control Adult Mosquitoes Following Hurricanes Katrina and Rita. Wing Beats 17 (2) 7–15

Received: December 14th, 2007
Accepted: December 17th, 2007
OnlineFirst: December 18th, 2007

Appendix 8: DVA Australia, The Third Vietnam Veterans Mortality Study 2005, Chapter 6 – Results.



6

Results

Chapter 6 Results

This chapter presents the results of the mortality analysis. It describes veteran mortality for broad disease groups of the International Classification of Diseases (ICD) and specific diseases of interest within some of the groupings. Mortality by branch of Service is also reviewed.

6.1 Overview of analysis

This study investigated the mortality of the Vietnam veterans from the time of completion of their first Vietnam service to 31 December 2001. Results are presented as standardised mortality ratios (SMR). The SMR is the ratio of observed deaths among Vietnam veterans to the expected number of deaths among male Australians of the same age in the same time period.

As described in Chapter 4, due to the uncertainty of the vital status of the 2.7% of veterans lost to follow-up, the SMR results are presented using two scenarios for the population at risk:

- Scenario 1 excludes veterans whose status is unknown from the at-risk population. These veterans are effectively treated as average compared to the other veterans, which may or may not be true. If the mortality rate of those lost to follow-up is substantially different from those whose fate is known, then the SMR using this scenario would be an over or under-estimate of the true situation.
- Scenario 2 includes veterans whose status is unknown to the at-risk population, and assumes that they are still alive and residing in Australia at the end of the follow-up on 31 December 2001. The effect of including veterans whose status is unknown is that the expected number of deaths may be over-estimated. This is because the veteran population under Scenario 2 is not adjusted for their possible death or migration out of Australia.

Calculation of SMR by themselves is insufficient for determining whether veterans experienced significantly higher or lower mortality than might be expected. Calculation of the 95% CI is used to determine whether the higher or lower mortality experienced by veterans is statistically significantly different from what would be expected or whether the differences could be due to chance. A 95% CI that excludes 1.0 indicates the result is statistically significant.

By convention this statistical significance is at the 0.05 level, which means there is up to a one in twenty probability the result could be due to chance. Thus the concept of multiple comparisons should be considered. This report investigates over 60 specific causes of cancer and non-cancer mortality, which means that some results which the 95% CI indicate are statistically significant, by definition could have up to a one in twenty probability to be

due to chance. In the current situation where 60 tests are performed, three such cases would be expected to be due to chance.

As discussed in Chapter 4, issues of study power, as well as statistical significance, need to be considered when interpreting the results presented in this report. The size of the group being studied, the magnitude of the effect observed and the rate of occurrence of a cause of death influence statistical power.

Complete results are tabled in Appendix D. This chapter focuses on those results that show a statistically significant difference from the rates expected in the Australian population. As differences between the two analysis scenarios are minor, results from Scenario 1 only are presented in this chapter to enhance readability.

6.2 Mortality of Vietnam veterans

There were a total of 6,166 deaths among the 59,179 Vietnam veterans. The most frequent causes of death were neoplasms (2,058), circulatory diseases (1,767) and external causes of death such as suicide and motor vehicle accidents (1,394). These three mortality groups account for 85% of all deaths observed.

Overall mortality for military Vietnam veterans was 6% lower than expectation, SMR 0.94, (95% CI 0.92, 0.97). Table D1 in Appendix D shows the SMR and their confidence intervals for all causes and specific causes for the Vietnam veteran cohort for both Scenarios.

The SMR and 95% CI for all causes of death and 31 specific causes are shown in Figure 6-1. Specific causes were chosen because of *a priori* interest or because they are representative of the Australian community. Interpretation of these figures is described in Chapter 4, section 4.6.4.

There were no causes of death that were significantly more common than expected under either scenario except suicide by gas. Mortality from neoplasms and alcoholic liver disease was significantly elevated by 6% and 19%, respectively in Scenario 1 but not significantly in Scenario 2. Several causes of death were significantly lower than expected and are detailed in Table 6-1.

Notably mortality from diseases of the circulatory system and respiratory system, which are among the leading causes of death for this age group in the Australian population,[1] was significantly lower than expected.

The HIV pandemic did not result in increased mortality among Australian Vietnam veterans as compared to the general Australian community. There were 39 deaths observed in this population of Vietnam veterans, whereas based on the mortality in the Australian community of males of the same age and time there would have been 49 deaths expected.

Table 6-1: Standardised Mortality Ratios (SMR) for causes of death which were significantly lower than expected: all Vietnam veterans

Cause of Death	Number of deaths	SMR	95% CI
All causes	6,166	0.94	0.92, 0.97
Infectious diseases[a]	33	0.62	0.41, 0.83
Endocrine diseases	94	0.62	0.49, 0.74
Diabetes	55	0.52	0.38, 0.66
Mental and behavioural disorders	51	0.61	0.45, 0.78
Nervous system diseases	91	0.78	0.62, 0.94
Circulatory system diseases	1,767	0.88	0.84, 0.92
Ischaemic	1,297	0.94	0.89, 0.99
Stroke	223	0.80	0.70, 0.91
Respiratory system diseases	239	0.77	0.67, 0.87
COPD[b]	128	0.85	0.70, 1.00[c]
Digestive system - Peptic ulcers	12	0.55	0.27, 0.93
Genitourinary system diseases	30	0.66	0.42, 0.90
Congenital abnormalities	6	0.24	0.09, 0.52
External causes - Assault	31	0.56	0.36, 0.76

[a] excludes AIDS deaths

[b] Chronic obstructive pulmonary disease

[c] Borderline statistical significance

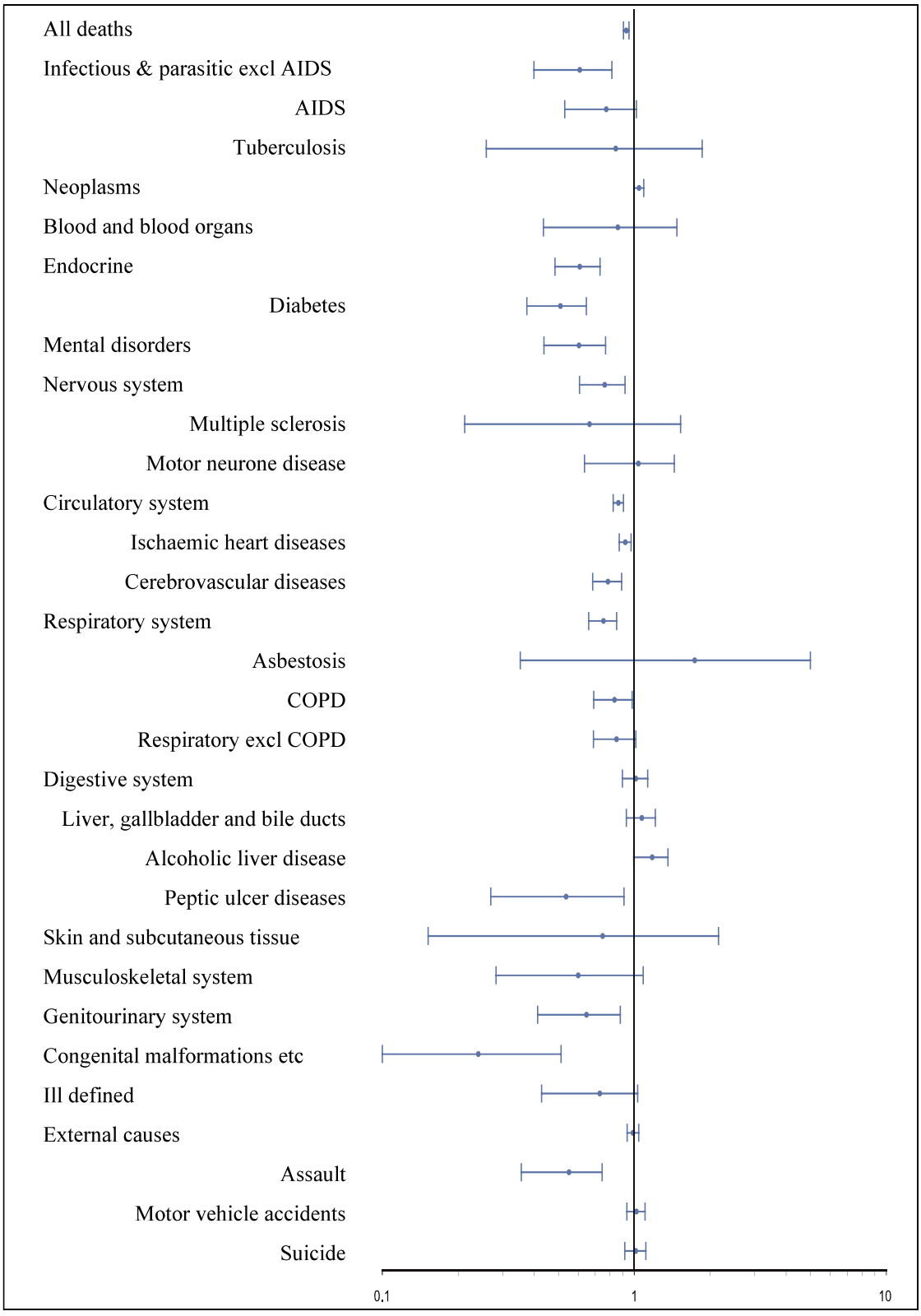


Figure 6-1: Standardised Mortality Ratios (SMRs) and 95% CIs for all Vietnam veterans

6.3 Deaths from diseases of *a priori* interest

In developing the protocol for this study, several causes of death were considered to be of particular interest due to results of previous studies, reviews of the literature or concerns of veteran organisations. These specific *a priori* causes of death are listed in the protocol in Appendix B. Minor changes have been made to the list of diseases to compensate for changes in coding practices and availability of data. Data for the infectious disease group excludes deaths from AIDS as coding for AIDS deaths had been allocated to different disease groups prior to the present standardisation. Also, cirrhosis of the liver was changed to alcoholic liver disease.

Table 6-2 provides the SMR for those diseases of *a priori* interest. Of the nine non-neoplastic causes of death, the mortality rates of three (infectious diseases, ischaemic heart disease, and neurological diseases) were significantly lower than the rates of the Australian population. Furthermore there was a decrease in COPD which was of borderline significance. The mortality rates from digestive disease, motor neurone disease, suicide and motor vehicle accidents did not differ from expectation. Significantly higher mortality from alcoholic liver disease was observed for Vietnam veterans in Scenario 1 only.

Mortality from cancer was 6% higher than expected. Mortality for individual cancer sites of *a priori* interest is discussed in Section 6.5.

Table 6-2: Standardised Mortality Ratios (SMR) for *a priori* causes of death for the Vietnam veteran cohort

Cause of Death	Number of deaths	SMR	95% CI
All causes	6,166	0.94	0.92, 0.97
Infectious diseases[a]	33	0.62	0.41, 0.83
Neoplasms	2,058	1.06	1.02, 1.11
Ischaemic heart disease	1,297	0.94	0.89, 0.99
Chronic obstructive pulmonary disease	128	0.85	0.70, 1.00
Digestive diseases	292	1.03	0.91, 1.15
Alcoholic liver disease	161	1.19	1.01-1.38
Neurological diseases	91	0.78	0.62, 0.94
Motor neurone disease	25	1.06	0.64, 1.47
Suicide	421	1.03	0.93, 1.13
Motor vehicle accidents	553	1.03	0.95, 1.12

[a] excludes AIDS deaths

6.4 Mortality by branch of Service

Mortality was investigated by branch of Service. Table 6-3 details the number of deaths and person years that contributed to the analysis by Service branch.

Table 6-3: Number of deaths and person years contributed by branch of Service

Service Branch	Number of veterans contributing to the analysis[a]	Number of unknowns	Number of deaths	Person Years contributed	
				Unknowns Excluded	Unknowns Included
Navy	13,538	445	1,435	435,387	446,199
Army	41,084	1,028	4,045	1,289,433	1,312,549
Air Force	4,570	105	686	138,999	141,331
Total	59,179	1,578	6,166	1,863,394	1,899,654

[a] Total is less than sum due to 13 servicemen having served in two branches.

6.4.1 Mortality of Navy Vietnam veterans

There were 1,435 deaths among the 13,538 Navy Vietnam veterans. The most common causes of death were from neoplasms (491), circulatory diseases (399) and external causes of death such as suicide and motor vehicle accidents (340), comprising 86% of all observed deaths.

Navy veterans had an overall mortality which was not significantly different from the Australian population, SMR 1.00, (95% CI 0.95, 1.06). The SMR and 95% CI for all causes of death and 31specific causes are shown in Figure 6-2.

Two causes of death analysed revealed higher than expected mortality rates: cancer and suicide by gas. Mortality from cancer among Navy veterans was 19% higher than expected, SMR 1.19, (95% CI 1.08, 1.29). Mortality from specific cancers types is discussed in Section 6.5.

Mortality from several causes of death was significantly lower than expected. These are listed in Table 6-4. Mortality from all other causes was not significantly different from expectation.

Complete results can be found in Table D2, Appendix D.

Table 6-4: Standardised Mortality Ratios (SMR) for causes of death which were significantly lower than expected: Navy Vietnam veterans

Cause of Death	Number of deaths	SMR	95% CI
Diabetes	12	0.54	0.28, 0.94
Mental and behavioural disorders	9	0.48	0.22, 0.89
Respiratory system diseases	50	0.76	0.55, 0.97

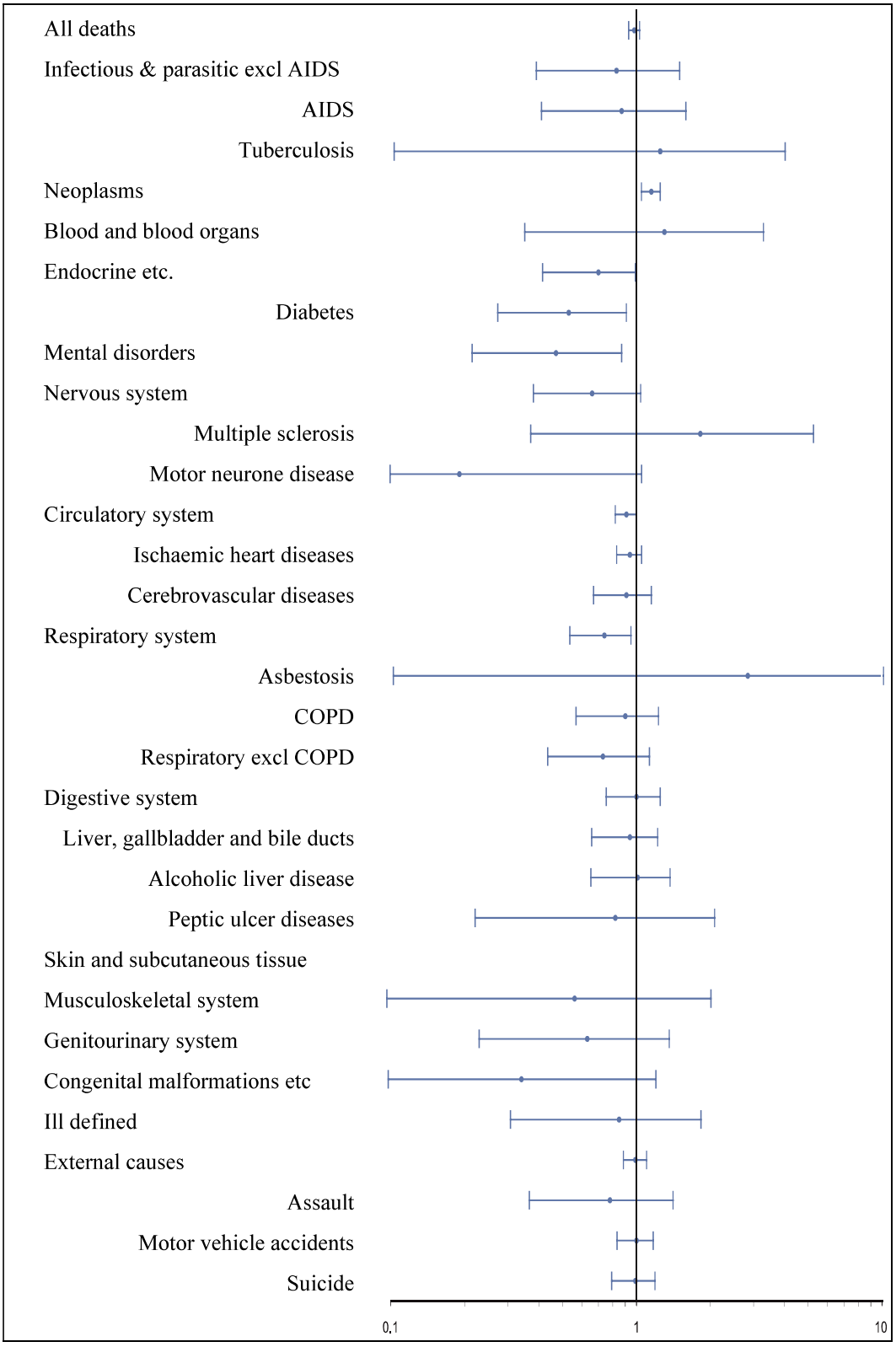


Figure 6-2: Standardised Mortality Ratios (SMRs) and 95% CIs for Navy Vietnam veterans

6.4.2 Mortality of Army Vietnam veterans

There were 4,045 deaths among the 41,084 Army Vietnam veterans. The most common causes of death were from neoplasms (1,323), circulatory diseases (1,136) and external causes of death such as suicide and motor vehicle accidents (954), comprising 84% of all observed deaths.

Army veterans had an overall mortality which was 7% lower than expected, SMR 0.93, (95% CI 0.90, 0.96). The SMR and 95% CI for all causes of death and 31 specific causes are shown in Figure 6-3.

None of the causes of mortality analysed showed a higher than expected mortality rate for Army veterans in both Scenarios. However, mortality from several causes of death was significantly lower than expected. These are listed in Table 6-5. Notably, mortality from respiratory diseases, circulatory diseases and specifically cerebrovascular disease or stroke was lower than expected. Mortality from all other causes was not significantly different from expectation.

Complete results can be found in Table D3 Appendix D.

Table 6-5: Standardised Mortality Ratios (SMR) for causes of death which were significantly lower than expected: Army Vietnam veterans

Cause of Death	Number of deaths	SMR	95% CI
All deaths	4,045	0.93	0.90, 0.96
Infectious diseases[a]	19	0.54	0.32, 0.83
Endocrine diseases	60	0.59	0.44, 0.74
Diabetes	37	0.52	0.35, 0.69
Mental and behavioural disorders	38	0.68	0.46, 0.89
Nervous system diseases	60	0.76	0.57, 0.95
Circulatory diseases	1,136	0.86	0.81, 0.91
Cerebrovascular	128	0.70	0.58, 0.83
Respiratory diseases	162	0.80	0.68, 0.92
Digestive diseases – Peptic ulcers	7	0.49	0.19, 0.98
Genitourinary diseases	18	0.62	0.36, 0.96
Congenital abnormalities	3	0.18	0.04, 0.51
External causes – Assault	20	0.53	0.30, 0.76

[a] excludes death from AIDS

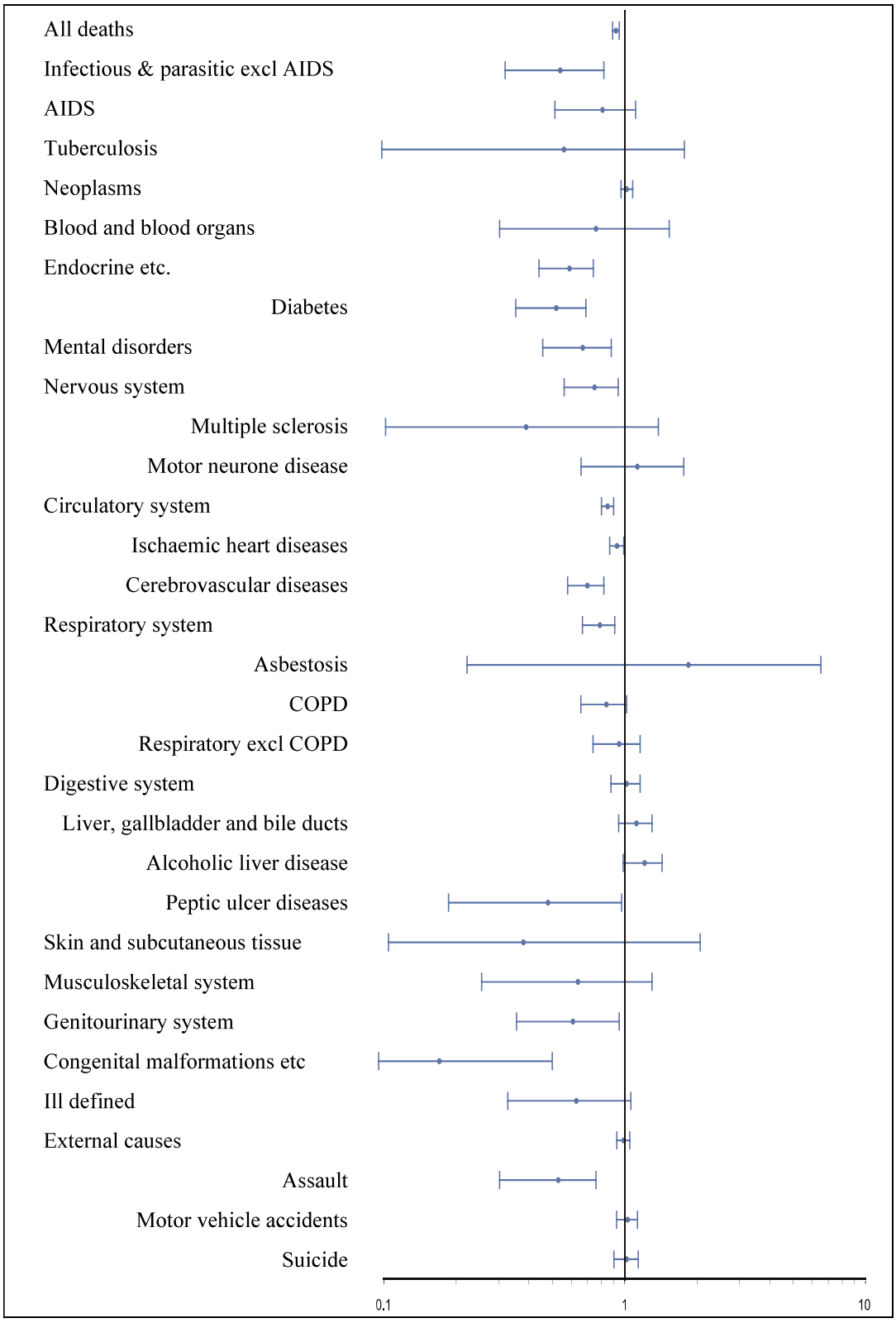


Figure 6-3: Standardised Mortality Ratios (SMRs) and 95% CIs for Army Vietnam veterans

6.4.3 Mortality of Air Force Vietnam veterans

There were 686 deaths among the 4,570 Air Force Vietnam veterans. As for all Vietnam veterans, the most common causes of death were from neoplasms (245), circulatory diseases (234) and external causes of death such as suicide and motor vehicle accidents (98), comprising 84% of all observed deaths.

Air Force veterans had an overall mortality which was 9% significantly lower than expected, SMR 0.91, (95% CI 0.42, 0.98). The SMR and 95% CI for all causes of death and 31specific causes are shown in Figure 6-4.

None of the causes of mortality analysed showed a higher than expected rate for Air Force veterans. However, mortality from several causes of death was significantly lower than expected and these are listed in Table 6-6.

Table 6-6: Standardised Mortality Ratios (SMR) for causes of death which were significantly lower than expected: Air Force Vietnam veterans

Cause of Death	Number of deaths	SMR	95% CI
All deaths	686	0.91	0.84, 0.98
Diabetes	6	0.46	0.17, 0.98
Circulatory diseases	234	0.87	0.76, 0.98
Ischaemic heart disease	161	0.86	0.73, 0.99
Respiratory diseases	28	0.64	0.40, 0.88

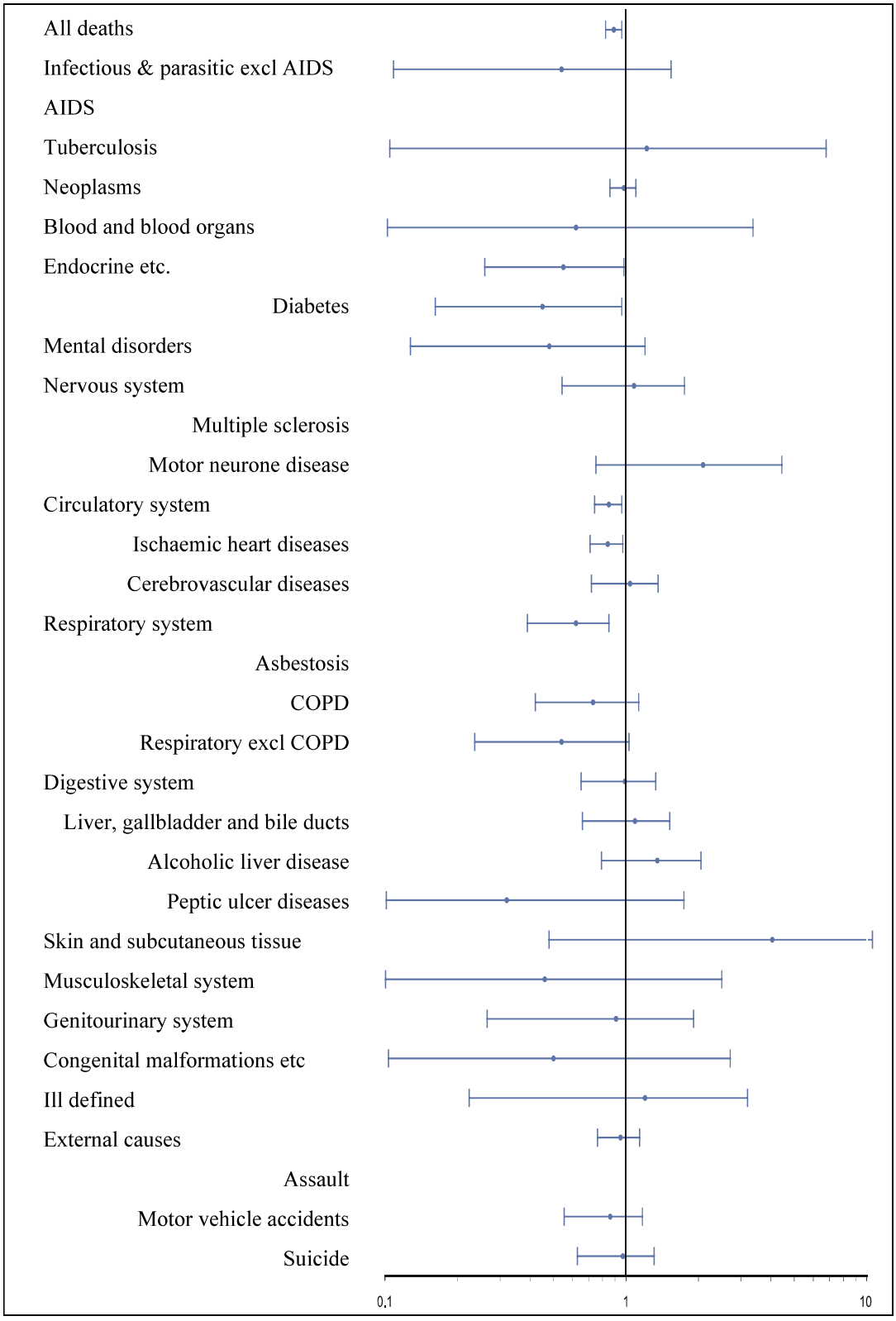


Figure 6-4: Standardised Mortality Ratios (SMRs) and 95% CIs for Air Force Vietnam veterans

6.5 Mortality from Neoplasms

Mortality from all neoplasms was investigated by individual primary site. Table D5, Appendix D lists the SMR and 95% CI for 32 different cancers for all Vietnam veterans.

There were 2058 deaths due to neoplasms accounting for 33% of all deaths among Vietnam veterans. The most frequently occurring causes of cancer deaths were lung cancer (544), gastrointestinal cancers (329) and genitourinary cancers (197).

Overall cancer mortality and a number of individual cancer sites were of *a priori* interest for Vietnam veterans. These results are listed in Table 6-7. Mortality from cancer was 6% higher than expected among Vietnam veterans compared to the Australian male population, but this was of statistical significance for Scenario 1 only, SMR 1.06, (95% CI 1.02, 1.11).

Mortality from one individual cancer of *a priori* interest was significantly lower than expected (non-Hodgkin's lymphoma) and two rates were significantly higher than expected (lung cancer and head and neck cancer). In addition, mortality from cancer of the oral cavity, pharynx and larynx, which includes head and neck cancer, was significantly higher than expected. There was also increase in mortality from prostate cancer, which was of borderline significance.

The SMR and 95% CI for all neoplasms and 32 specific cancers among all Vietnam veterans are shown in Figure 6-5.

Table 6-7: Standardised Mortality Ratios (SMR) for cancers of *a priori* interest: Vietnam veteran cohort

Cause of Death	Number of deaths	SMR	95% CI
Neoplasms	2,058	1.06	1.02, 1.11
Bladder cancer	22	0.71	0.42, 1.01
Brain cancer	99	0.95	0.76, 1.13
Breast cancer	4	2.15	0.58, 5.42
Connective and soft tissue cancer	12	0.75	0.38, 1.28
Gastrointestinal cancers	329	0.96	0.86, 1.06
Head and neck cancers	101	1.44	1.16, 1.73
Hodgkin's disease	13	0.89	0.46, 1.49
Leukaemia	84	1.07	0.84, 1.30
Lung cancer	544	1.18	1.08, 1.28
Liver cancer	48	0.88	0.63, 1.13
Melanoma	111	1.10	0.90, 1.31
Multiple myeloma	24	0.86	0.52, 1.20
Non-Hodgkin's lymphoma	70	0.78	0.60, 0.96
Prostate cancer	107	1.23	0.99, 1.46
Testicular cancer	14	0.85	0.43, 1.39
Thyroid cancer	2	0.51	0.06, 1.78

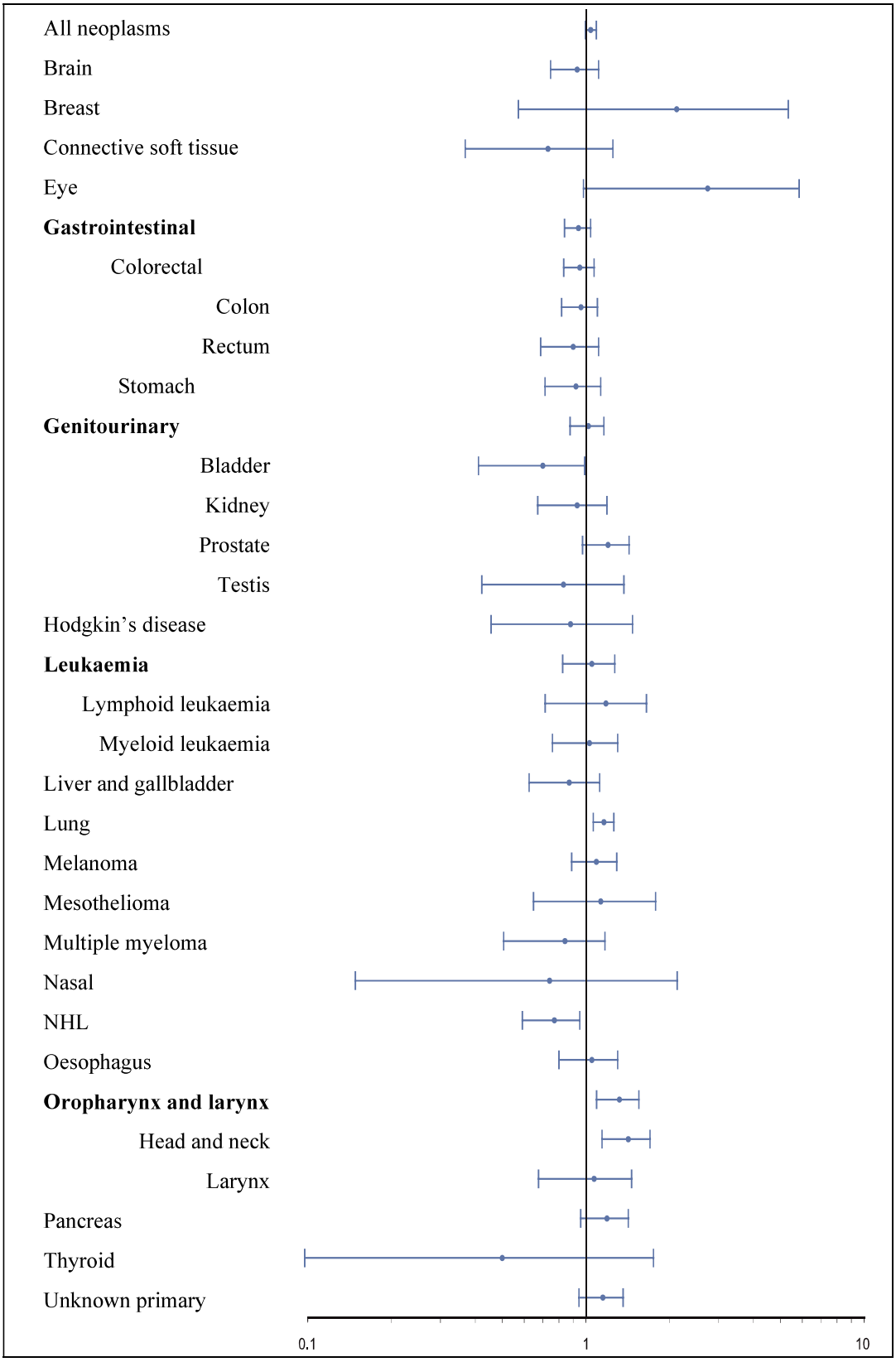


Figure 6-5: Standardised Mortality Ratios (SMR) and 95% CIs for cancer deaths amongst all Vietnam veterans

6.5.1 Cancer mortality among Navy Veterans

Table D6, Appendix D shows the distribution of the 491 deaths from neoplasms among the Navy Vietnam veterans. The most frequently occurring causes of cancer deaths were from lung cancer (135), gastrointestinal cancer (86) and genitourinary cancer (43).

Overall Navy veterans had a 19% significantly higher than expected mortality from neoplasm. Specifically, mortality from lung cancer, melanoma and mesothelioma were higher than expected whereas death from non-Hodgkin's lymphoma was lower than expected. Table 6-8 shows the results. Mortality from all other cancers analysed did not differ from expectation.

Table 6-8: Standardised Mortality Ratios (SMR) for cancer deaths which were significantly lower or higher than expected: Navy Vietnam veterans

Cause of Cancer Death	Number of deaths	SMR	95% CI
Non-Hodgkin's lymphoma	10	0.52	0.25, 0.94
Lung	135	1.39	1.15, 1.62
Melanoma	35	1.56	1.04, 2.08
Mesothelioma	8	2.53	1.11, 4.94
All neoplasms	491	1.19	1.08, 1.29

6.5.2 Cancer mortality among Army Veterans

Table D7, Appendix D shows the distribution of the 1,323 deaths from neoplasms among the Army Vietnam veterans. The most frequently occurring causes of cancer deaths were from lung cancer (339), gastrointestinal cancer (206) and genitourinary cancer (122).

Overall mortality from neoplasms among Army veterans was not significantly different from the Australian population. There were no individual cancers for which mortality was lower than expected. However, mortality from lung cancer (Scenario 1 only), cancer of the oral cavity, pharynx and larynx and its subgroup, head and neck cancer was higher than expected. Mortality from eye cancer was also significantly higher than expected based on 5 deaths. Table 6-9 shows the results. Mortality from all other cancers analysed did not differ significantly from the Australian population.

Table 6-9: Standardised Mortality Ratios (SMR) for cancer deaths which were significantly higher than expected: Army Vietnam veterans

Cause of Cancer Death	Number of deaths	SMR	95% CI
Eye	5	3.43	1.09, 7.85
Lung	339	1.13	1.01, 1.25
Oral cavity, pharynx and larynx	88	1.39	1.10, 1.68
Head and neck	69	1.49	1.14, 1.84

6.5.3 Cancer mortality among Air Force Veterans

Table D8, Appendix D shows the distribution of the 245 deaths from neoplasms among the Air Force Vietnam veterans. The most frequently occurring causes of cancer deaths were from lung cancer (71), gastrointestinal cancer (38) and genitourinary cancer (32).

Overall mortality from neoplasms amongst Air Force veterans was not significantly different from the Australian population. Among individual cancers mortality from stomach cancer was significantly lower than expected, SMR 0.41, (95% CI 0.10, 0.98). Mortality from all other cancers analysed was not significantly different from expectation. However, there was a marked but non-significant elevation in mortality from lymphoid leukaemia (six deaths identified where two were expected).

In summary, Figure 6-6 compares the SMR and 95% CI for selected cancers by Service branch.

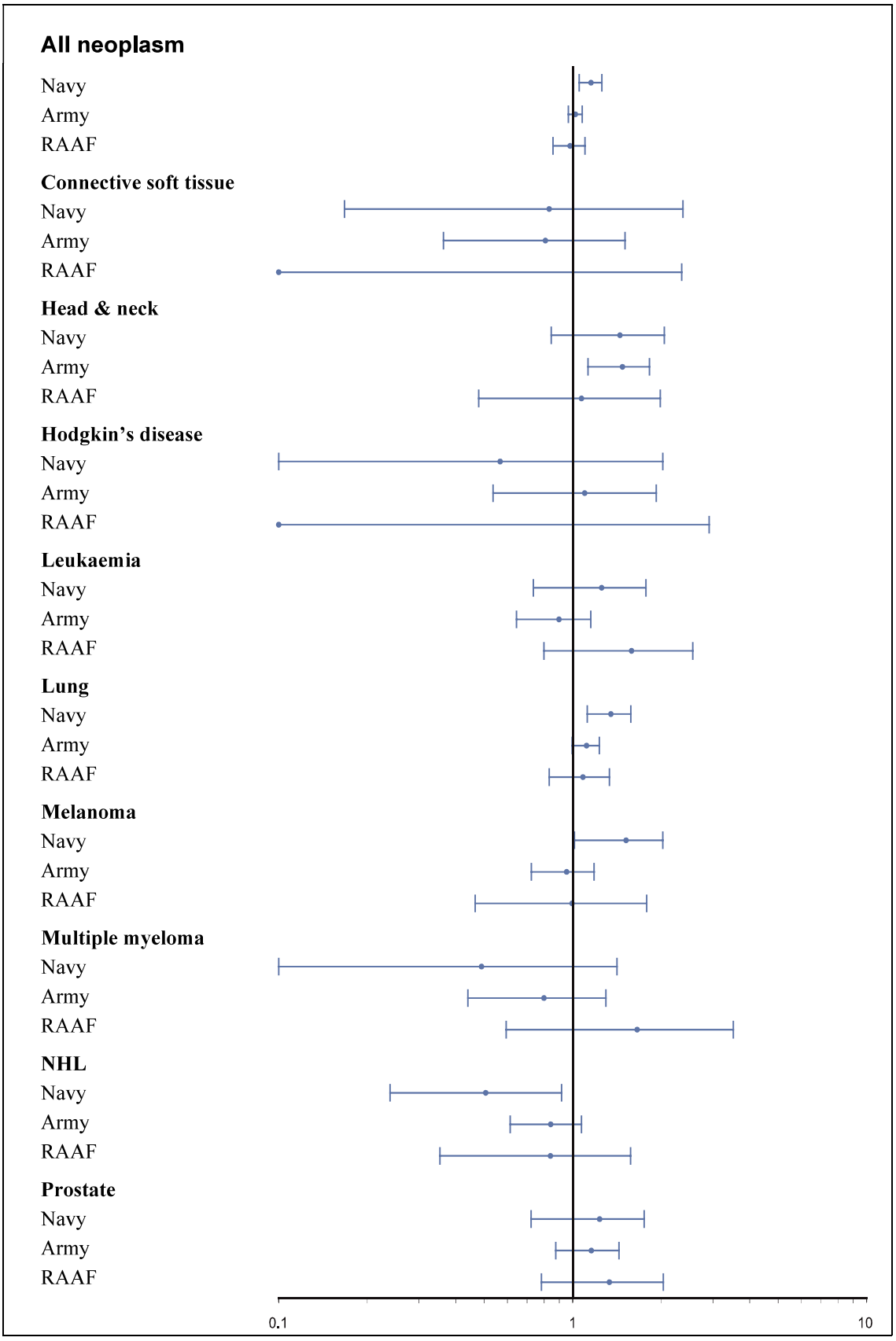


Figure 6-6: Standardised Mortality Ratios (SMRs) and 95% CIs for selected cancers by Service branch

6.6 Change in mortality over time

As is discussed more fully in Chapter 7, consideration of the healthy worker effect is important for interpreting the results of this mortality study. Briefly, Vietnam veterans were a selected group of healthy, fit men at the time of the commencement of their service. Thus they would be expected to have a lower mortality compared to the Australian community which includes men at all levels of fitness and health. This effect diminishes with time from enlistment and is more pronounced for certain disease groups, such as some congenital diseases, that would have been screened for at enlistment.

Table 6-10 illustrates the change in SMR over time for all Vietnam veterans for selected disease groups. The time in follow-up is divided into three periods of approximately one decade each. The results in Table 6-10 show that, in general, standardised mortality ratios increased over time and the overall mortality ratio in the most recent period was SMR 0.99 (95% CI 0.96, 1.02). With the exception of circulatory and infectious diseases, the mortality rates were not significantly lower than the Australian community in the latest time period. Thus, although over the more than thirty years of follow-up in this study overall mortality and mortality for many of the disease groups analysed were significantly lower than expectation, in the most recent decade mortality ratios generally were not different from expectation.

The mortality from external causes was stable over time and reflects a decrease in deaths from motor vehicle accidents and an increase in mortality from suicide. Mortality from diseases of the liver, gall bladder and bile ducts and specifically alcoholic liver disease were significantly higher than expected in the latest time period, SMR 1.25, (95% CI 1.04, 1.47) and SMR 1.48, (95% CI 1.20, 1.76), respectively.

Table 6-11 describes the change in SMR for selected cancers. The change in cancer mortality over time showed a mixed pattern. The mortality from some cancers, such as all neoplasms, cancer of the eye, colon, and to a lesser extent pancreas showed the highest mortality rate in the middle time period from 1980 to 1990, although not all these values were statistically significant. In the latest time period mortality from all neoplasms, cancers of the prostate, lung, and oral cavity, pharynx and larynx were significantly higher than expected. Also mortality from Hodgkin's disease and melanoma were non-significantly elevated in the latter time period.

It is important to note that many cancers have a long latency period from exposure to any possible etiological factor to disease development. The majority of cancers would develop decades after any exposure to potential carcinogens.

Table 6-10: Change in SMRs over time for all Vietnam veterans

	1963 – 1979				1980-1990				1991-2001			
Cause of death	**Observed**	**Expected**	**SMR**	**95% CI**	**Observed**	**Expected**	**SMR**	**95 % CI**	**Observed**	**Expected**	**SMR**	**95% CI**
All deaths	1,059	1,291	0.82	0.77–0.87	1,751	1,853	0.95	0.90–0.99	3,356	3,386	0.99	0.96–1.02
Infectious diseases excluding aids	3	10	0.36	0.06–0.92	8	13	0.64	0.28–1.24	21	31	0.69	0.40–0.98
Neoplasm diseases	145	177	0.82	0.68–0.95	553	492	1.12	1.02–1.21	1,360	1,266	1.07	1.02–1.13
Circulatory diseases	186	271	0.69	0.59–0.79	546	622	0.88	0.80–0.95	1,035	1,114	0.93	0.87–0.99
Ischaemic	124	177	0.70	0.58–0.82	421	443	0.95	0.86–1.04	753	764	0.99	0.92–1.06
Stroke	35	43	081	0.54–1.07	59	81	0.73	0.54–0.92	129	156	0.83	0.69–0.97
Respiratory diseases	8	44	0.19	0.08–0.36	58	79	0.74	0.55–0.93	173	187	0.93	0.79–1.06
COPD[1]	N/A				30	36	0.85	0.55–1.15	97	113	0.86	0.68–1.03
Respiratory minus COPD	N/A				27	44	0.62	0.39–0.85	76	74	1.03	0.80–1.27
Digestive diseases	36	42	0.86	0.58–1.14	87	95	0.92	0.73–1.12	170	147	1.16	0.98–1.33
Liver, gall bladder and bile ducts	23	27	0.87	0.52–1.22	64	70	0.91	0.69–1.14	134	105	1.27	1.06–1.49
Alcoholic liver disease	15	16	0.96	0.53–1.57	40	47	0.85	0.59–1.12	108	73	1.48	1.20–1.76
Musculoskeletal diseases	0	2	0.00	0.00–1.80	2	4	0.50	0.06–1.77	8	11	0.77	0.34–1.50
Genitourinary diseases	3	11	0.29	0.06–0.81	5	9	0.54	0.17–1.23	21	25	0.87	0.50–1.23
Congenital diseases	1	10	0.10	0.00–0.55	1	6	0.17	0.00–0.95	4	9	0.44	0.12–1.12
Unknown causes diseases	4	11	0.37	0.09–0.89	8	8	0.97	0.43–1.91	10	11	0.95	0.45–1.73
External diseases	652	650	1.00	0.93–1.08	416	414	1.00	0.91–1.10	327	327	1.00	0.89–1.11
Assault	9	20	0.47	0.20–0.84	13	21	0.64	0.33–1.07	8	14	0.58	0.25–1.12
MVA	374	338	1.11	1.00–1.22	123	130	0.94	0.78–1.11	56	67	0.83	0.61–1.05
Suicide	112	130	0.86	0.70–1.02	150	142	1.06	0.89–1.23	159	139	1.15	0.97–1.33

[1] COPD – chronic obstructive pulmonary disease

Table 6-11: Change in cancer mortality over time for all Vietnam veterans

	1963 – 1979				1980-1990				1991-2001			
Cause of cancer death	**Observed**	**Expected**	**SMR**	**95% CI**	**Observed**	**Expected**	**SMR**	**95 % CI**	**Observed**	**Expected**	**SMR**	**95% CI**
All neoplasms	145	177	0.82	0.68–0.95	553	494	1.12	1.02–1.21	1,360	1,266	1.07	1.02–1.13
Brain and CNS	13	16	0.81	0.39–1.33	30	30	1.02	0.66–1.39	56	59	0.94	0.70–1.19
Eye	1	0	4.77	0.11–25.21	3	1	5.40	1.10–15.53	2	1	1.44	0.17–5.11
Gastrointestinal	22	26	0.84	0.49–1.19	98	90	1.08	0.87–1.30	209	226	0.92	0.80–1.05
Colon	16	14	1.16	0.62–1.81	64	47	1.37	1.04–1.71	97	120	0.81	0.64–0.97
Colorectal	18	19	0.95	0.53–1.44	76	65	1.17	0.91–1.43	153	173	0.89	0.75–1.03
Genitourinary	12	16	0.73	0.34–1.23	37	37	0.98	0.66–1.30	148	135	1.10	0.92–1.28
Prostate	1	1	0.77	0.02–4.05	11	13	0.89	0.44–1.57	94	73	1.29	1.03–1.55
Hodgkin's	3	7	0.44	0.09–1.21	4	5	0.87	0.23–2.19	6	3	2.04	0.74–4.37
Leukaemia	17	15	1.10	0.60–1.70	22	22	1.01	0.59–1.43	45	41	1.08	0.77–1.40
Lung	17	29	0.59	0.32–0.90	151	121	1.25	1.05–1.45	376	312	1.21	1.08–1.33
Melanoma	16	17	0.93	0.49–1.45	35	32	1.08	0.72–1.44	61	52	1.18	0.88–1.47
Mesothelioma	N/A				N/A				18	15	1.22	0.71–1.89
NHL	8	10	0.85	0.36–1.59	23	23	1.01	0.60–1.42	39	57	0.67	0.46–0.89
Oesophagus	4	3	1.62	0.42–3.93	15	13	1.20	0.66–1.95	48	48	1.00	0.71–1.28
Oral cavity, pharynx and larynx	3	6	0.53	0.10–1.46	33	26	1.26	0.82–1.69	93	64	1.45	1.16–1.75
Pancreas	5	6	0.92	0.28–2.04	30	20	1.49	0.96–2.02	65	57	1.14	0.86–1.41
Unknown	9	6	1.69	0.73–3.03	23	25	0.95	0.57–1.34	87	73	1.20	0.95–1.46

6.7 Summary

This chapter presented the results of the mortality analysis for Vietnam veterans from the time they returned from Vietnam to December 2001. Overall Vietnam veterans had a 6% lower than expected mortality rate compared to the Australian male population. However, the difference in mortality between the two groups was no longer present in the most recent time period.

The most common causes of death were cancer, circulatory diseases and external causes such as suicide and motor vehicle accidents and this was consistent across the Service branches.

Of the nine non-neoplastic causes of death of *a priori* interest, the mortality rates of three (infectious diseases, ischaemic heart disease and neurological diseases) were significantly lower compared to the Australian population. Mortality rates from digestive disease, chronic obstructive pulmonary disease (Scenario 1 only), motor neurone disease, suicide and motor vehicle accidents did not differ from expectation. A significantly higher mortality from alcoholic liver disease was observed for Vietnam veterans in Scenario 1, which was particularly evident in the most recent time period.

In addition, of the 36 causes of death analysed, Australian Vietnam veterans had a lower than expected mortality from several of the specific causes, including mortality from circulatory diseases, respiratory diseases and infectious diseases. However this difference from expectation had essentially disappeared in the most recent time period analysed.

Of the three Services, mortality amongst Navy veterans was not significantly different from the Australian population but their mortality from cancer was 19% higher than expected. Overall mortality amongst Army and Air Force veterans was significantly lower than expected and no single non-cancer cause of death was significantly elevated under either analysis Scenario. Mortality was significantly lower than expected for diabetes and respiratory diseases across all Services, and Army and Air Force veterans also had lower than expected mortality for circulatory diseases.

Mortality from specific cancers was investigated. Although statistically significant in Scenario 1 only, overall cancer mortality was 6% higher than expected. Mortality from lung cancer and cancer of the head and neck region was significantly higher than expected, whereas mortality from non-Hodgkin's lymphoma was lower than expected. Furthermore, mortality from cancers of the eye and prostate were borderline significantly elevated.

Amongst the Services cancer mortality was significantly elevated for Navy veterans only. However there were significant differences for individual cancers between the Services. There was a higher than expected cancer mortality from lung cancer, melanoma and mesothelioma amongst Navy veterans whereas Army

veterans had a higher than expected mortality from cancers of the eye, oral cavity, pharynx and larynx and head and neck.

The change in SMR over time was investigated. In general, standardised mortality ratios increased with increasing time from Vietnam service, illustrating a diminution of the healthy worker effect on this male military cohort. By the most recent decade the mortality for most of the causes of death analysed were no longer significantly lower than expectation. Mortality from neoplasms and liver disease was significantly higher than expectation in the latest time period. Mortality from prostate cancer was of borderline significance overall, and was significantly elevated in the most recent time period.

Chapter 7 discusses the results presented in this chapter in the context of community norms and findings of previous studies.

References:

1 Australian Bureau of Statistics, *Causes of Death* cat no. 3303.0, Canberra, 2000.

Appendix 9: DVA Australia, Vietnam Veterans Family Study Factsheet.

Vietnam Veterans Family Study

- Aim: To determine the effect, if any, that active Vietnam service had on the physical, mental and social wellbeing of the sons and daughters of Australian Vietnam veterans.
- $11.5 million.
- Over 27,000 study participants including veterans, partners and their children.

Research contributors

- Australian Institute of Family Studies (AIFS)
- Australian Institute of Health and Welfare (AIHW)
- Open Mind Research Group Pty Ltd
- Taylor Nelson Sofres Research Australia Pty Ltd
- Enhance Management Pty Ltd
- Colmar Brunton Social Research Pty Ltd

Key findings (compared to Vietnam-era personnel)

The majority of children of Vietnam veterans were leading healthy and productive lives. However they were more likely to:

- be diagnosed with or treated for depression (21% vs 14%), anxiety (22% vs 13%) or post-traumatic stress disorder (PTSD) (4% vs 1%);
- have suicidal thoughts (41% vs 31%), suicidal plans/actions (12% vs 7%);
- have skin conditions (21% vs 14%), migraines (13% vs 7%) and experience sleep disturbances (15% vs 9%).

Australian Government
Department of Veterans' Affairs

Vietnam Veterans Family Study

The Vietnam Veterans Family Study (VVFS) is the most significant research program ever undertaken by the Australian Government into the health of the families of Australia's Vietnam veterans.

The Department of Veterans' Affairs undertook this study to better understand the long-term impacts of service on the health and welfare of the families of Vietnam veterans.

The study examined the physical, mental and social health of Vietnam veterans and their families, covering a broad range of health outcomes for these people.

Over 27,000 people participated in the studies, comprising veterans, partners and their children. These included:

- 10,000 randomly selected Army Vietnam veterans and their families including their partners, ex-partners, children, stepchildren, brothers, sisters, nieces and nephews; and
- 10,000 randomly selected Defence Force personnel who served in the Army during the Vietnam War era (1962-1975) but did not deploy to Vietnam and their families including their partners, ex-partners, children and stepchildren. This provided a control group representing comparable families.

A Scientific Advisory Committee of independent research experts provided oversight of the study and a Consultative Forum represented the veteran community perspective.

The key findings found that the majority of sons and daughters born to Vietnam veterans are leading healthy and productive lives. However, analysis found that the families of Australia's Vietnam veterans are more likely to have significant emotional, physical, and social problems when compared to families of those who served in that era who did not go to Vietnam.

The key factors that appeared to explain the intergenerational impact of deployment were:

- servicemen's posttraumatic stress disorder (PTSD);
- harsh parenting in childhood among the offspring of Vietnam veterans; and
- problems at school among the sons and daughters of Vietnam veterans.

When examining mortality amongst the children of Vietnam veterans, the research found that the children of Vietnam veterans and Vietnam-era personnel had lower mortality rates when compared to the general population, and that there were no significant differences in deaths from cancer.

The research shows that operational service affects more than just the person who serves; it can also impact on family members.

The research did not find a causal link between a father being exposed to Agent Orange and the health of children.

Support

For veterans and their families, including sons and daughters of Vietnam veterans, help is available through the Veterans and Veterans Families Counselling Service (VVCS). VVCS provides free and confidential, nation-wide counselling and support for war and service-related mental health and wellbeing conditions.

In addition, all Vietnam veterans are eligible for a Gold Card at age 70.

For help, to learn more or to check eligibility call 1800 011 046 (24/7) or visit www.vvcs.gov.au. Further support tools and information is available through http://at-ease.dva.gov.au.

The suite of VVFS reports is available on the DVA website at *www.dva.gov.au/vvfs*. If you have any enquiries call the DVA Health Study Information Line on 1800 502 302.

more info contact DVA Media
Email: dvamedia@dva.gov.au
Phone: +61 (0) 2 6289 6203

Appendix 10: "Insecticide Deceit?: the truth about insecticides used at Nui Dat", John Mordike, 2013.

Insecticide deceit?: the truth about insecticides used at Nui Dat

By John Mordike*

Introduction

Over the last two years I have undertaken a study on the use of insecticides at the 1 ATF base at Nui Dat, the home of the Australian and the New Zealand fighting force in Vietnam. The most important finding of this study is that much of the truth about insecticide use by 1 ATF has never been revealed.

Taking a broad perspective, my study has revealed the roles played by the Army, the Department of Veterans' Affairs and the Department of Primary Industry in the examination and reporting of the use of insecticides by the Australian Army in Vietnam.

This article narrows the focus. It presents a synopsis of the findings of my study in relation to the use of insecticides at Nui Dat.

The article is based on primary source documents from Army's Vietnam records. The records are held by the Research Centre, Australian War Memorial, Canberra, and are available to the public for research under the terms of the Archives Act (1983).

After the passage of forty years and a Royal Commission in 1983-5, it is time the truth was revealed.

Developments at Nui Dat in 1970

In August 1970, the Officer Commanding Detachment 1 Field Hygiene Company at Nui Dat realised that very serious errors were being made with the use of insecticides. He brought his concerns to the attention of Headquarters 1st Australian Task Force (HQ 1 ATF), Nui Dat. In turn, HQ 1 ATF wrote to Headquarters Australian Force Vietnam (HQ AFV), located in Saigon, with the advice that:

> *'All insecticides/pesticides containing **DIELDRIN** are to be withdrawn from issue, as in the Hygiene Officer's opinion **the use of this chemical in any form is dangerous to humans** …'.*

The Hygiene Officer's advice about Dieldrin was correct. He subsequently advised that Dieldrin's toxicity was officially rated as *'Extremely Toxic'*. Dieldrin was a very dangerous chemical and it posed real dangers for human health and the environment. But there were other very dangerous insecticides being used at Nui Dat, such as Chlordane, Lindane and Diazinon.

How toxic were these insecticides?

On 22 May 2001, delegates from 120 nations, including Australia, signed an international treaty banning **twelve of the world's most dangerous chemicals** in Stockholm. The dangerous chemicals were described as *'persistent organic pollutants* [which] *are among the most dangerous of all manufactured products and toxic wastes* ***which cause fatal diseases and birth defects in humans*** *and animals'.*

Dieldrin was one of those chemicals. Chlordane was another.

Both of these insecticides were used regularly at the 1 ATF base at Nui Dat.

The Hygiene Officer's advice should have brought a stop to the use of Dieldrin, at least, in 1970. But it did not.

Army's Supply Policy on Insecticides was Flawed

Although Dieldrin and Chlordane were banned internationally in 2001, their extreme toxicity and danger to human health were known in the 1970s. Yet Army supply policy failed to reflect this.

When the Hygiene Officer's advice to cease using Dieldrin was considered at HQ AFV in August 1970, it was realised that Army's official supply policy placed no restrictions on the issue and use of Dieldrin and any other insecticides with *'extremely toxic'* and *'very toxic'* ratings. According to Army's documented supply policy, any unit could request these highly dangerous insecticides. Furthermore, personnel dispersing them required no qualifications or training. It was a very serious policy error.

My research has shown that, as a result of the policy and lack of awareness, *'extremely toxic'* and *'very toxic'* insecticides were dispersed at Nui Dat over a period of years in alarming volumes. An indication of the quantities involved will be given later in this article.

Remarkably, the realisation in August1970 that the Army's supply policy was wrong produced no changes in the issue and use of Dieldrin, Chlordane and other dangerous insecticides at Nui Dat. The same insecticides were used again without restriction in 1971.

Two Classes of Insecticides

To assist in understanding what happened at Nui Dat, it is necessary to understand how insecticides are classified and how they work.

Insecticides are divided into two classes which dictate the way in which they are intended to be used:

- Knockdown Insecticides; &,
- Residual Insecticides

Everyone will be familiar with Knockdown Insecticides. They are the insecticides that we use in our homes in pressure-pack spray cans. The insecticide is released into the air in the form of an aerosol or vapour. Knockdown insecticides are also dispersed by mosquito coils and, for larger areas, by fogging and misting. The insect comes into physical contact with the vapour or aerosol, generally when in flight. The pyrethrum in the spray paralyses the insect while another mild toxic element kills the insect. Because of their low toxicity, Knockdown Insecticides are relatively safe to use in areas of human habitation.

Residual Insecticides function differently. This class of insecticides is designed to be sprayed or applied directly to hard surfaces, sometimes plants but generally buildings, where it forms a film which eventually dries and crystallises. When the insect alights on, or crawls over, the treated surface and remains in contact with the treated surface for a period of time, it is poisoned and dies. To be effective, Residual Insecticides require a high degree of toxicity and they also need to be persistent, that is, they need to be long lasting. Only properly trained personnel should use these insecticides in special circumstances under close supervision.

Significantly, documents show that when the Hygiene Officer's representations were considered at HQ AFV in August 1970, it was realised that the Army had no bulk Knockdown Insecticide in its inventory. It never had. Therefore, all area spraying and fogging at Nui Dat was executed with Residual Insecticides alone. This supply problem was never rectified. The only Knockdown Insecticide available was in the hand-held pressure-pack spray can.

The following table lists the range of Residual Insecticides used by the Army in Vietnam. The toxicity rating of each – taken from the Hygiene Officer's documents at the time – are also shown. It will be noted that Dieldrin and Chlordane were two of the most toxic insecticides.

Residual Insecticide	**Toxicity Rating**
Dieldrin	Extremely Toxic
Chlordane	Extremely Toxic
Lindane	Extremely Toxic
Diazinon	Very Toxic
DDT	Moderately Toxic
Malathion	Slightly Toxic

Although Malathion was rated as *'slightly toxic'* in the 1970s, in July 2006, the United States Environmental Protection Agency reported the results of research that: *"Malathion … is converted to its metabolite,* ***malaoxon*** *… in insects and mammals'.* The US EPA reported that

tests on rats showed that Malaoxon was *'61x more toxic to adults* [rats] *than malathion'*. When Malathion was dispersed it could convert to Malaoxon through oxidation in water treatment processes or through reaction with ambient air. It was inevitable that Malathion dispersed from aircraft over Nui Dat would settle on Rowe's Lagoon, the open water supply for Nui Dat. During the wet season, Residual Insecticides would also have found their way into the water supply through run-off.

Further Developments at Nui Dat in 1970

In September 1970, a month after he first raised the issue of insecticides, the Hygiene Officer wrote to HQ 1 ATF and HQ AFV with the advice that:

> *'Residual insecticides are **dangerous poisons** and therefore are issued and used only by trained Army Health personnel.'*

Apparently, the Hygiene Officer did not know that Army supply policy permitted the *'dangerous poisons'* to be issued freely to any unit and to be dispersed by unqualified personnel. The officer then explained briefly how Residual Insecticides worked and highlighted the problem with the use of insecticides at Nui Dat:

> *'It has been the incorrect practice in the past to use Residual insecticides in a knock down capacity.'*

Dispersing Residual Insecticides as though they were Knockdown Insecticides was a largely ineffective method of eradicating insects, but, significantly, as the Hygiene Officer pointed out to HQ 1 ATF and HQ AFV, it was ***'somewhat dangerous to humans'.***

Toxic insecticides could enter the human body through inhalation, ingestion and absorption through the skin.

As a result of the Hygiene Officer's advice, a senior medical officer was alerted to the problem with insecticide use at Nui Dat. He commented that:

> *'It is obvious that previous insecticide practice in 1 ATF is* [sic] *unsound.'*

And again in his end-of-tour report the same medical officer noted that:

> *'Use of insecticides in 1 ATF has not been subject to adequate control.'*

Before leaving Vietnam on 23 December 1970, the senior medical officer directed the Hygiene Officer to prepare an AFV policy document on the use of insecticides.

In the draft policy document, the Hygiene Officer recommended that:

> *'the chlorinated hydrocarbons, CHLORDANE, LINDANE, DDT and DIELDRIN and any other of this group of insecticides be removed from the scale of issue to Aust forces in Vietnam'.*

There is no evidence that the AFV insecticide policy document was ever promulgated. But, sadly, there is abundant evidence that the same errors with insecticide dispersal were made at Nui Dat during the next wet season in 1971; Residual Insecticides continued to be dispersed in a knockdown capacity. Indeed, it is evident the method of dispersal in 1971 was somewhat more dangerous for human health than it had been in the past.

The Wet Season of 1971 at Nui Dat

On 15 May 1971, the Commander of 1 ATF issued Routine Order Part 1, Serial 28, Number 111. The subject of the Order was *'Medical – Prevention of Insect-Borne Diseases'.*

In the introductory paragraph, the Order explained that insect-borne diseases had caused high manpower loss in previous wet seasons and, therefore, a co-ordinated campaign had been designed for 1971 to combat the insect threat. Spraying insecticide from Australian aircraft was to be the centrepiece of the campaign. In previous years, US fixed-wing aircraft had sprayed insecticide over Nui Dat.

According to the Routine Order, the 1971 campaign was based on *'the latest medical advice'* and was to consist of the following measures:

> *'(1) **Residual** spraying by fixed and rotary-wing aircraft initially at fortnightly and later at weekly intervals.*
>
> *(2) **Residual** spraying of bunkers and building interiors.*
>
> *(3) Ground fogging of unit areas with **residual** and knock down sprays.'*

Remarkably, the campaign was based almost entirely on the use of Residual Insecticide and, of most concern, the aerial dispersal of Residual Insecticide.

Unfortunately, the Hygiene Officer who had warned in September – just 8 months previously - that Residual Insecticides were ***'dangerous poisons'*** and that using them as though they were Knockdown Insecticides was **'somewhat dangerous to humans'** was no longer serving at Nui Dat. He had returned to Australia on 7 April.

Veterans who served at Nui Dat in 1971 recall that, each week, the aerial spraying was executed by Iroquois helicopters from 9 Squadron RAAF. Documents show that the helicopter spraying commenced on 25 May 1971.

My research has revealed that the documented medical advice given to the Commander 1 ATF, like the Commander's subsequent Routine Order, failed to specify a particular insecticide to be used in the aerial and ground spraying or fogging dispersal campaign. The medical advice simply stated that the class of Residual Insecticides was to be used in both aerial and ground dispersal. The lack of specific advice opened the door for the use of dangerous insecticides.

Two Veterans Speak Up

In 1982, one veteran, who served at Nui Dat with 3rd Battalion RAR as a member of the regimental hygiene squad, submitted a statutory declaration to a Senate Enquiry on pesticide use in Vietnam. The veteran said his duties *'included dispersing Malathion and **Dieldrin** with a swing fog device'*. He went on to explain that he *'did not dilute any chemicals'* during his service at Nui Dat from February to October 1971. *'Nor did any of the men I worked with to the best of my knowledge.'* The veteran continued:

> *'We sprayed to kill mosquitoes, cockroaches, scorpions and snakes. The fog was dispersed under floorboards of tents, into tents occupied by soldiers, between sandbags around tents, around grease pits and rubbish cans, and kitchen waste areas.'*

While undertaking this spraying, the veteran stated that he wore no protective clothing, nor did his workmates. The veteran also stated that after returning from Vietnam he had *'suffered from a number of medical problems including depression, nervousness and many bouts of irrational behaviour'*. His sons also had *'medical problems'*. The veteran died in May 2011, aged 66.

Another veteran, who had served with 12 Field Regiment based at Nui Dat in 1968-69 and again, in 1970, for a total of eight months with the Detachment 1 Field Hygiene Company at Nui Dat, gave evidence to the same Senate Enquiry observing that:

> *'The high incidence of malaria and encephalitis caused operators and supervisors to lift concentrations to very high toxicity to achieve a kill. Many sprays were over three times the usual concentration and mixed into cocktails of different chemicals.'*

This veteran died in 1994 at the age of **46**

What Quantities of Insecticides were used at Nui Dat?

On 15 October 1968, a Supply and Transport staff officer on HQ 1 ATF, wrote to the Deputy Assistant Director of Supply and Transport on HQ AFV, informing him of the results of a survey of certain expense supplies that were demanded by units at Nui Dat over a three-month period. The quantities of insecticides being consumed at

Nui Dat were included in the survey and they are presented in the following table.

Insecticide	**Amount Used at Nui Dat in 3 Months - 1968**	**Toxicity Rating**
Dieldrin	600 gallons	Extremely Toxic
Chlordane	520 gallons	Extremely Toxic
Lindane Powder	216 two-ounce cans	Extremely Toxic
Diazinon Liquid	600 gallons	Very Toxic
Diazinon Powder	300 pounds	Very Toxic
DDT	222 gallons	Moderately Toxic
Malathion	520 gallons	Slightly Toxic

The supply officer who completed the survey recommended that these usage rates be adopted to establish the working stock levels for supply units at Nui Dat.

These are alarming quantities. In a three-month period in 1968, 1,120 gallons of *'extremely toxic'* Dieldrin and Chlordane alone had been dispersed at Nui Dat. Remember that both of these chemicals were among **the world's twelve most dangerous chemicals** that were banned internationally in 2001.

It should be remembered that while the Australians were dispersing these quantities of insecticides at Nui Dat from ground-based equipment, US fixed-wing aircraft were also aerially spraying the base with either Malathion, or, perhaps, DDT, each fortnight.

The quantities of insecticides being used in 1968 were not an aberration. Other Australian supply documents from Vietnam show that in mid-1970 there were 285 gallons of Dieldrin in stock with a further 300 gallons on order, 35 gallons of Chlordane with a further 100 gallons due in, 100 gallons of Lindane Liquid with 300 gallons due in, and so on with similar amounts for the other Residual Insecticides.

Why hasn't this information come to light before?

Responding to the public controversy over the spraying of herbicides in early 1982, Army Headquarters, Canberra, established a research project to examine its 21,000 working files from the Vietnam war – the very same records used to write this article. While the original aim of

the Army's research project was to determine what herbicides had been used, the scope of the project was expanded to include insecticides and other chemicals that had been used by the Army in Vietnam. Although this was essentially an Army project, Department of Veterans' Affairs also played a part in the research and writing.

The work of the research project was completed in May 1982. The findings were incorporated in a large, complex document which was known thereafter as the Army Report. But the original May version of the Army Report was subject to some amendment action before Minister of Defence Mr Ian Sinclair presented the report to Parliament in December 1982. Mr Sinclair had already explained in October that the *'original version of the report* [had] *been revised to add information where a more detailed description was felt necessary;* [to] *make minor corrections such as spelling and typographical corrections; and* [to] *make other editorial changes to improve the flow of the report.'*

The December version of the Army Report became an evidentiary base for information on the exposure of Australian veterans to Agent Orange, insecticides and other chemicals. Indeed, in relation to insecticides, the Army Report was used by, and quoted extensively in, the final report of the Royal Commission.

What becomes clear as a result of my recent study is that, on the subject of insecticides, the Army Report is a most unsatisfactory document. Indeed, I have discovered it to be riddled with obfuscation, omissions and misleading comments. For the sake of brevity, only three examples are considered here.

Failure to Report Aerial Spraying in 1971 When the Army Report examined the contents of the medical advice given to the Commander 1 ATF in May 1971 to implement an insect eradication campaign, the report gave precedence to the ground spraying program and simply failed to mention the aerial dispersal element. Likewise, when the Army Report mentioned the Commander's subsequent Routine Order to implement the campaign, it reported that the order detailed *'the contents of a coordinated campaign against insect-borne disease'.* And that is all. The contents of the campaign were not reported.

Therefore, in a remarkable omission, the Army Report failed to mention the aerial spraying program of Residual Insecticides that was undertaken on a weekly basis using 9 Squadron RAAF helicopters. Aerial dispersal was the centrepiece of the whole campaign. This was a critical omission because it had implications for veterans' health.

The Royal Commission accepted the Army Report as it stood, so it too failed to report that RAAF helicopters had undertaken a weekly

spraying campaign of Residual Insecticide at Nui Dat, commencing on 25 May 1971.

Thus Vietnam veterans were denied the possibility of Repatriation medical treatment and benefits for illnesses that may have been caused by exposure to these Residual Insecticides.

Obfuscation over Amount of Dieldrin Dispersed Similar unsatisfactory reporting was evident when the Army Report detailed the quantities of insecticides dispersed at Nui Dat.

The Army Report claimed that it could report accurately the quantities of each insecticide used at Nui Dat on a monthly basis from December 1967 to September 1971 because a detailed set of 1 ATF accounting records existed. So the Army Report listed all of the insecticides in all their forms that were used at Nui Dat. For example, there were 133,557 large pressure-pack aerosol cans, 2,832 pounds of Diazinon powder, 123,502 three-ounce bottles of insect repellent and 2,360,350 packs containing 150 Dapsone tablets. It was also reported that 2,792 gallons of Malathion and 2,940 gallons of Chlordane were dispersed by Australians at Nui Dat. Yet in the midst of all this accounting accuracy, it was remarkable that Dieldrin alone was the exception.

In the Army Report that was submitted to Parliament in December 1982, the amount of Dieldrin issued at Nui Dat over the four-year period was simply listed as 430. But 430 what? The units of quantity were not mentioned.

To claim that detailed Army accounting records did not designate what quantity of Dieldrin was being issued, while all other insecticides were accurately accounted for, is nonsense. While I have never been able to locate the detailed accounting records cited in the Army Report, I have found a number of documents in the Army records held by the Australian War Memorial that show that Dieldrin came from a US source in 5 gallon drums and that the Australian unit of issue was the gallon.

Further highlighting the unsatisfactory reporting of the quantity of Dieldrin issued, readers will also recall that the survey of usage rates at Nui Dat reported that 600 gallons of Dieldrin had been issued at Nui Dat in just a three-month period in 1968. The Army Report, however, did not mention this documented fact.

Was this misreporting, incompetence or something more?

Again, the Army Report misled the Royal Commission. The final report of the Royal Commission reproduced the usage rates listed in the Army Report showing that 430 had been issued at Nui Dat, while noting *'quantity not specified'*. Obviously, the commission took

no further action to find out the truth on this matter; it simply accepted the Army Report without question.

A Significant Deletion in the Army Report As already explained, there were two versions of the Army Report. The first was completed in May 1982, but, before being submitted to Parliament in December, some amendments were made.

In the following extract from the original May version of the report, I have emphasised in bold type certain words. These words were used to describe the 1 ATF Hygiene Officer's initial concerns about the use of insecticides at Nui Dat:

> *'**The concern, that untrained personnel were apparently using toxic insecticides without any knowledge of concentrations, dilution factors, human toxicity factors and general safety precautions**, resulted in the intended publication in Routine Orders of information on safe insecticide practice.*
>
> Note : *A draft routine order was discovered but it is not known whether it was actually published.'*

This statement was a succinct, realistic assessment of the situation.

But the statement was amended before submission to Parliament. And the amendment was certainly beyond the scope of the revisions explained to Parliament by Minister of Defence Mr Ian Sinclair in October.

The words I emphasised in bold type from the original May version were deleted and the following statement substituted in the December version:

> *'The 1 ATF Hygiene officers* [sic] *concern that practices for the use of toxic insecticides needed improvement resulted in the intended publication in Routine Orders of information on safe insecticide practice.'*
>
> Note : *A draft routine order was discovered but it is not known whether it was actually published.'*

Who deleted the words *'that untrained personnel were apparently using toxic insecticides without any knowledge of concentrations, dilution factors, human toxicity factors and general safety precautions'?*

On 25 November 1982, Mr Phill Thompson, National President of the Vietnam Veterans' Association of Australia put out a press release claiming that Department of Veterans' Affairs officers were *'currently revising'* the original May version of the Army Report before its submission to Parliament in December. Further evidence

from an Army officer working in Army Office at that time supports this claim.

Whoever the culprits, it is clear they intentionally removed vital information describing a longstanding dangerous misuse of toxic insecticides. Why? The original words highlighted negligent practice in the use of insecticides that could have led to searching questions during the Royal Commission. It is also clear that the original words would have helped veterans pursue claims for medical treatment and compensation.

A Concluding Comment

The above examples raise key questions. Was information about the use and misuse of toxic insecticides deliberately omitted or deleted from the Army Report and to what end? Were any omissions and deletions made to protect those guilty of possible negligence or to deny exposed veterans grounds for their lawful benefits? And exactly what part did the Department of Veterans' Affairs play?

Given the rates and methods of dispersal of Residual Insecticides and their toxicity and persistence in the environment, it is clear that the Nui Dat base was an increasingly toxic and dangerous environment for human habitation. Consequently, it is highly probable that the health of Australian and New Zealand veterans was adversely affected. I believe that a thorough examination of the morbidity of these veterans is warranted.

As a final comment, it is certain that the Australian Army will never again use herbicides – at least not on the scale and in the way that they were used in Vietnam – but the Army will be using insecticides. It is essential that the protocols developed for the use of these chemicals consider the safety and well-being of soldiers as the first priority.

John Mordike

3 September 2013

*John Mordike is a Vietnam veteran and professional historian. He graduated from the Royal Military College in 1966 and served in Vietnam as the Officer Commanding 12 Field Regiment LAD. He has a BA and LittB from the University of New England and a PhD from the University of New South Wales. He is the author of *'An Army for a Nation : A history of Australian military developments 1880-1914'* and *'"We should do this thing quietly" : Japan and the great deception in Australian defence policy 1911-1914'.*

Appendix 11: HQ Australian Force Vietnam Dapsone Trial Instruction

(COPY)

RESTRICTED

ANNEX A TO
FINAL REPORT
ON AFV TRIAL NO 9/68

AUSTRALIAN MILITARY FORCES

R980-500-47

Headquarters
Australian Force
VIETNAM

16 Oct 68

See Distribution List

AFV (ARMY COMPONENT) TRIAL INSTRUCTION NO 9/68
EFFECTIVENESS OF DAPSONE-PALUDRINE AS A MALARIA SUPPRESSANT

General

1. There is every good reason to believe that a drug called 'Dapsone', if taken in conjunction with Paludrine, gives added protection against malaria. It is strongly emphasised that Dapsone taken on its own will not give significant protection and that it must be taken in conjunction with another suppressant.

2. Dapsone has been used previously in conjunction with Quinine and Primaquine for the treatment of malaria, and the effectiveness of this treatment is well documented. This instruction describes the procedure for the evaluation of Dapsone and Paludrine when used together as a malaria suppressant.

Aim

3. To determine the effectiveness of Dapsone with Paludrine as a Falciparum malaria suppressant.

Trial Units

4. The following units are to conduct the trial:

a. 1 RAR

b. 9 RAR (on arrival in SVN)

c. 4 RAR (excluding V and W Coys)

d. 12 Fd Regt (excluding 161 Bty)

Trial Officers

5. Each of the trial units is to appoint a Unit Trial Officer, who is to supervise the conduct of the trial within his unit in accordance with this instruction. 1 ATF is to appoint a Trial Coordinating Officer, through whom Unit Trial Officers are to pass all results and questions relating to this trial to HQ AFV (FORS, Deer 273). 1 ATF is to signal the names of the Unit Trials Officers and Coordinating Officer to HQ AFV by 19 Oct 68.

Conduct of the Trial

6. Two platoons of each rifle company and one section of both field batteries are to receive one Dapsone tablet per man per day in addition to the normal two Paludrine tablets per man per day. The Dapsone tablet is to be taken by each member of the selected platoons and Artillery sections at the morning Paludrine parade.

7. The remaining elements of each rifle company and the remaining sections of the field batteries are to act as control to the trial. They are to take only the normal two Paludrine tablets per man per day.

(COPY)

RESTRICTED

8. Daily records are to be kept by the Trial Officer, as per Annex A, showing the following information:

a. Platoon/gun section strength actually on Operations.

b. Platoon/gun section strength within 1 ATF perimeter.

c. Location of platoons/gun sections, and rifle company headquarters at 1800 hrs, when on operations.

9. The Coordinating Officer is to advise HQ AFV by 20 Oct 68 which platoons and gun sections are selected to use the Dapsone-Paludrine tablet combination.

Trial Period

10. The trial is to commence on 23 Oct 68 and continue for at least one month. Depending on the significance of the results, the number of operational days, and the areas in which the operations are conducted, it may be necessary to extend the trial period for a further one or two months, to ensure that the effectiveness of Dapsone-Paludrine is fully tested.

Trial Stores

11. Dapsone tablets are to be drawn by Unit Trial Officers from SMO 1 ATF.

Reports

12. A report on the significance of the results of the trial is to be issued by FORS, HQ AFV, one month after the start of the trial and at monthly intervals subsequent to this should the trial period be extended. The classification of the Trial Report is to be RESTRICTED.

Publicity

13. No publicity is to be given to this trial without the prior approval of HQ AFV.

(sgd) M. BRADBURY
Colonel
Chief of Staff

Annex: A. Daily Records

Distribution:

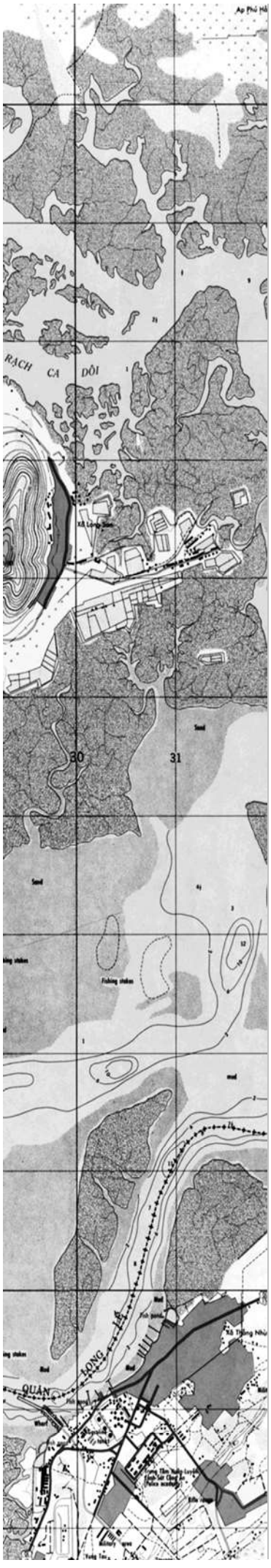
1 ATF (12)

For information:

AHQ (C)
AHQ (M)
HQ 1 ALSG
1 Aust Fd Hosp
SMO 1 ATF
HQ NZ V Force
HQ RAAFV

Internal:
FORS
GSO3 (SD and Trg)
ADMS; ADPR; DADST

Appendix 12: Australian DVA Report on Dapsone Trial in South Vietnam



1

Introduction

Chapter 1 Introduction

1.1 Background

The health and wellbeing of Vietnam veterans and their families has been an important issue for the Department of Veterans' Affairs which has conducted three extensive health studies between 1983 and 2006 on the military personnel deployed to Vietnam. The aim of these studies has been to increase the understanding of the impact of military service and to further support Vietnam veterans through targeted programs of care, compensation, rehabilitation and commemoration.

The impact of possible chemical exposure has been a key issue in the study of the health of Vietnam veterans. The initial focus was on herbicides such as Agent Orange. This focus was extended by the Royal Commission established in 1983 investigating the Use and Effects of Chemical Agents on Australian Personnel in Vietnam (the Evatt Royal Commission)[1].

Dapsone was one of the drugs investigated by the Evatt Royal Commission. During the Vietnam conflict, Australian forces used Dapsone for the treatment and prevention of falciparum malaria. The Evatt Royal Commission recommended the study of the carcinogenicity of Dapsone. This recommendation was supported by the assessment and recommendation report to the Evatt Royal Commission (the Hogg report) in 1987 that urged the immediate establishment of an epidemiological study into the effects of Dapsone on deployed military personnel[2].

In 1992, the Australian Institute of Health and Welfare published the results of the study *Dapsone Exposure, Vietnam Service and Cancer Incidence* commissioned by the Department of Veterans' Affairs[3]. This study found no evidence that Dapsone exposure was associated with an increase in total cancer incidence.

The purpose of the present study is to examine the rates of mortality and cancer incidence among veterans who were given Dapsone while serving in Vietnam. It repeats some of the analysis done by AIHW previously. This report extends the previous report with an additional 11 years of follow-up and therefore potentially captures details of types of cancer that occur in an older population.

This chapter gives the history of the use of Dapsone by the Australian Army in the Vietnam conflict. A general description of Australia's involvement in Vietnam is also given and this is followed by the history of the use of Dapsone by those forces. The aim of this chapter is to provide some background information for those unfamiliar with Australia's involvement in Vietnam, and to allow the reader to understand who received Dapsone and why. A more detailed history of the Vietnam conflict is provided in *Cancer Incidence in Australian Vietnam Veterans Study 2005*[4].

1.2 History of Australian involvement in Vietnam

1.2.1 Location

Vietnam is located on the eastern rim of the Indo-Chinese peninsula, stretching from the Chinese border to its southern tip. Following the French defeat at Dien Bien Phu, the Geneva Conference of 1954 was established to settle the political future of Indo-China and Korea. One of the outcomes was the establishment of the Republic of Vietnam. The Geneva Accords of July 1954 fixed a provisional Demarcation Line at 17 degrees north. The region south of this line formed the Republic of Vietnam, while the northern region became the Democratic Republic of Vietnam. Despite their official titles, the countries became more commonly known as 'South' and 'North' Vietnam respectively.

1.2.2 Geography and climate

Most of the country, north and south, consists of a rugged highland region, the Annamite Chain, a jungle covered mountain range interspersed in its southern portion with fertile plateaux. These plateaux slope gradually to the valley of the Mekong River in the west, but rise sharply in the east, leaving a narrow coastal plain cut by spurs of the mountain chain. This region extends down from the northern borders to just north of Ho Chi Minh City (formerly known as Saigon).

The second important region in southern Vietnam is the Mekong Delta, a low level plain covering some 68,000 square kilometres which at no point is more than three metres above sea-level. The Delta is crisscrossed with streams, ditches and canals, which both irrigate the paddy fields and drain the seasonal floodwaters.

The third region is the Central Lowlands which extend along the coast from Phuoc Tuy province, east of Ho Chi Minh City, north to the Demarcation Line. In general, this region is fertile and extensively cultivated, although the immediate 160 kilometres north from Vung Tau receives less rainfall than any other part of Vietnam and is somewhat infertile.

Rainfall and temperature in South Vietnam is determined by the seasonal alternation of the monsoons. During the summer monsoon, moist air flows inland from the sea, depositing heavy rainfall in its passage. The monsoon normally arrives in Vietnam by June each year. During the winter monsoon, cool air flows outward towards the sea, producing the country's dry season. In most parts of Vietnam the season is 'dry' only in comparison with the southwest summer monsoon. The winter monsoon normally reaches the Central Lowlands by early October and the Mekong Delta area by November and continues to blow until April.

Except in a few mountainous areas, high temperatures prevail throughout the year and the humidity is generally high. The annual rainfall is heavy in all regions and torrential in many. In addition, typhoons off the South China Sea strike somewhere in Vietnam on average about ten times per year, usually between June and November.

1.2.3 Chronological overview

The following chronological overview relates specifically to Australian Defence Force involvement in the Vietnam conflict. The period of coverage under the *Veterans' Entitlement Act 1986* (*VEA*) for the Vietnam War has been established as 31 July 1962 to 29 April 1975. This section briefly outlines events that occurred during this period.

The departure from Australia in July 1962 of the first contingent of the Australian Army Training Team Vietnam (AATTV) began the Australian Army's commitment to the Vietnam War.

In 1965, the Australian involvement in Vietnam expanded. The Australian Army dispatched the 1st Battalion, The Royal Australian Regiment, and supporting units to Bien Hoa in South Vietnam. HMAS *Sydney* transported the bulk of the ground forces, and this voyage in May 1965 was the first of 25 voyages into the Vietnam War operational area. Other Navy vessels escorted the troop carrier on these occasions.

The period 1966 to 1967 has been described as a period of consolidation.[5, p217] Australian involvement was increased with the establishment of the 1st Australian Task Force that would contain two battalions, a Special Air Service squadron, and combat and logistical support units based at Nui Dat and the 1st Australian Logistic Support Group at Vung Tau.

The next phase of the war occurred from 1968 to mid 1969, when the task force was expanded with the addition of a third battalion. This period represents the peak strength of Australia's involvement.[5, p217-218]

The task force reverted to a two-battalion structure in November 1970. This marked the beginning of a gradual withdrawal with the remaining two battalions returning to Australian in 1971 and the last of the support units and AATTV personnel departing in 1972. The last Australian troops, the Australian Embassy Guard Platoon, Saigon, were withdrawn in June 1973.

The aim of this section has been to provide some background information to readers unfamiliar with Australia's involvement in the Vietnam War. Australian involvement was formally announced in May 1962. There was a gradual build up of numbers, peaking in 1968, followed by a gradual decline until the bulk of the troops had departed by the end of 1972. The last of the Australian troops left in June 1973.

1.3 History of Dapsone use

To understand the reasons behind the use of Dapsone in Vietnam, and the particular manner in which the drug was used, it is necessary to understand some of the history of malaria and the Australian Defence Force.

1.3.1 Malaria and its control

Malaria was a considerable problem to the Australian military in World War One.[6, p10] During World War Two, malaria control moved from being the responsibility of the medical staff to being a command responsibility. In particular, it was a command responsibility to ensure that appropriate malaria prophylaxis was taken everyday. This responsibility fell to the commanding officer of each unit.

By use of appropriate prophylaxis and discipline, the Australian Army was able to reduce the incidence of malaria in the South West Pacific to less than 1 per 1,000, 'the lowest figure in military history'.[6, p244]

This culture continued in the Australian Army during the time of the Vietnam War. Malaria control was viewed very seriously. In the early to mid 1960s, the standard malaria prophylaxis with the Army was Paludrine. In December 1966, forty-six cases of falciparum malaria occurred, mainly in 6 Battalion, Royal Australian Regiment (6RAR). There had been a breakdown in mosquito control measures in the area of operation and once the use of repellents and nets were given stricter observance the incidence of disease decreased.

However following another severe outbreak in 1968, there was emerging evidence that the malaria strains in the area that the Australian Army were serving (Phuoc Tuy Province) were resistant to Paludrine and additional prophylactic treatment regiments would be needed. Dapsone was considered a prime candidate for the additional drug regimen.

1.3.2 Pharmacology and uses of Dapsone

Dapsone is a sulfone drug (4,4-sulfonylbisbenzenamine or 4,4-diaminodiphenyl sulfone) that acts by inhibiting folate synthesis. Folate synthesis is an essential metabolic step in unicellular organisms, such as the malaria parasite, that cannot use preformed folates. As well as an anti-infective activity due to folate synthesis inhibition, Dapsone also has an anti-inflammatory action.

At the time of the Vietnam conflict, Dapsone had been in widespread clinical use for many years in the treatment of leprosy. In the early 1960s, promising results against chloroquine-resistant *P. falciparum* using Dapsone as a prophylactic agent were reported in field trials in Asia and Africa.[7-11]

1.3.3 Dapsone use by Defence Forces in Vietnam

In 1966, the US Army began field trials in Vietnam using a triple-drug regimen consisting of quinine, pyrimethamine and Dapsone. In September 1967, its use was recommended by the Senior Medical Officer in an instruction advising medical officers to treat falciparum malaria with a combination of quinine, pyrimethamine and Dapsone. Quinine dihydrochloide (1.8g per day) was given for three days and Dapsone (25mg per day) for 30 days.[3, p119]

Australians used a different drug combination to the Americans for anti-malarial prophylaxis. The basic treatment was 200mg Paludrine (Proguanil) per day administered as one 100 mg tablet in the morning and one in the evening. Debate continued within the Australian Army medical hierarchy whether the addition of Dapsone was necessary, and eventually it was agreed to undertake their own field trial of Dapsone in October 1968.[12, p154] The trial was not a clinical trial of Dapsone. Dapsone was a well established drug that had been used for many years, and had been shown to have anti-malarial properties. The point of the trial was to ascertain if the drug would work in the particular province (Phuoc Tuy) of Vietnam that Australians were operating in, and against the particular malarial parasites that were present in Phuoc Tuy province.

The trial supplemented the Paludrine regimen with 25mg Dapsone given with the morning Paludrine tablet. The trial proved successful.[13] Rates of malaria infection dropped close to zero. Dapsone was added to the daily anti-malarial treatment in November 1968. During the dry season in the Phuoc Tuy province Dapsone supplementation was discontinued as the risk of malaria was much lower and it was felt Paludrine only treatment was sufficient.

As outlined above, malaria prophylaxis was a very high priority in the Australian Army and excellent records were kept of the changes in malaria prophylactic regimens. The exact start and end dates of Dapsone supplementation to the treatment regimens was recorded. In addition, records are kept of who within the task force was given Dapsone.

Considerable effort was placed on ensuring that each person did receive their antimalarial prophylaxis. For example, in each infantry platoon, a non-commissioned officer would check that the tablets had been consumed. Thus the available documents provide an accurate retrospective exposure record of the consumption of this drug.

In this study cohort, a total of 23,262 members of the Australian Army who served in Vietnam were exposed to Dapsone, while a total of 16,945 Army veterans who served in Vietnam while Dapsone prophylaxis was not in use received no Dapsone. Thus this is a large population exposed to Dapsone, with a large and appropriately matched control group.

1.3.4 Adverse reactions to Dapsone

During the use of Dapsone in Vietnam, several cases of adverse reactions attributed to the drug were reported. In its use for leprosy, some very rare blood disease conditions such as aplastic or haemolytic anaemia and mononucleosis syndrome had been reported but these occurred at doses much higher than were being used in anti-malarial prophylaxis.[14] The first reported case of agranulocytosis (a decrease in the number of a type of white blood cell that is important in fighting infection) attributed to Dapsone was in 1958 in a patient treated with 100mg daily for dermatitis herpetiformis (a skin disease). The agranulocytosis was found to be reversible with the cessation of the drug.[15]

In 1969, the Americans reported 16 cases of agranulocytosis in soldiers receiving daily Dapsone prophylaxis in conjunction with chloroquine-primaquine tablets. Eight

of these soldiers died from overwhelming sepsis.[16] Three cases of agranulocytosis occurring amongst Australian troops between June 1969 and February 1970 and presenting as septicaemia were reported in the medical literature. All recovered with the withdrawal of Dapsone and antibiotic treatment.[17 18]

Subsequent research on the toxicity of Dapsone has shown that the risk of agranulocytosis in the treatment of leprosy is virtually zero whereas when taken in combination with antimalarial treatment, the risk at one in 10 – 20,000. The greatest toxicity risk for agranulocytosis occurs in patients taking Dapsone for the treatment of dermatitis herpetiformis whose risk is 25-35 times higher compared with patients without this condition.[19]

The mechanism by which Dapsone causes agranulocytosis is unknown. Several theories have been proposed. The hydroxylamine metabolic by-product could cause bone marrow toxicity but reversibility of the adverse affects following drug withdrawal suggests interference with specific mechanisms of cell control rather than basic toxicity.[19]

Other conditions associated with Dapsone have been investigated. Briton *et al* [20] assessed cancer mortality among patients with leprosy. Although they observed a slight elevation in overall cancer mortality and increase of cancer deaths for cancer of the oral cavity, bladder and kidney, no clear trends with Dapsone dose were seen. Hironaka[21] presented a case study of 12 leprosy patients with urinary tract carcinoma who had been taking high dose Dapsone and analgesics for many years. Although Dapsone has been implicated as a carcinogen in laboratory animals,[22] no clear association has been found in humans. Conversely the anti-infective and anti-inflammatory properties of malarial drugs have been suggested as playing a role in lower rates of Crohn's disease (an inflammatory intestinal disease) amongst Vietnam veterans.[23 24]

1.4 Summary

This chapter has provided some background information about Australia's involvement in the Vietnam War. Australian involvement was formally announced in May 1962. There was a gradual build up of numbers, peaking in 1968, followed by a gradual decline until the bulk of the troops had departed by the end of 1972. The last of the Australian troops left in June 1973. Air Force personnel participated in humanitarian flights and the final evacuation of Australian and Vietnamese civilians in 1975.

Malaria was endemic in Vietnam and the Australian Army went to great lengths to ensure the best possible prophylaxis was followed. In augmenting the drug regimen with Dapsone some adverse drug reactions were experienced, most notably among American troops. This lead to concerns that ingestion of Dapsone could have some long term adverse health effects for Australian Vietnam veterans.

This report is the second investigation into the effects of Dapsone amongst Vietnam veterans. It details the mortality and cancer incidence over more than 30 years since Dapsone ingestion and correlates these outcomes with total Dapsone dose.

References

1 Evatt P. Royal Commission on the use and effects of chemical agents on Australian personnel in Vietnam. Canberra: Commonwealth of Australia, 1985.

2 Hogg R. Royal Commission on the Use and Effect of Chemical Agents on Australian Personnel in Vietnam: an assessment and recommendations as a basis for a final Cabinet submission: n.p., 1987.

3 AIHW. Dapsone exposure, Vietnam service and cancer incidence. Canberra: Australian Institute of Health and Welfare, 1992:149.

4 Wilson E, Horsley KW, van der Hoek R. Cancer Incidence in Australian Vietnam Veterans study 2005. Canberra: Department of Veterans' Affairs, 2005:239.

5 Grey J. *The Australian Army. Vol I. The Australian Centenary History of Defence*. South Melbourne: Oxford University Press, 2001.

6 Sweeney T. *Malaria Frontline: Australian Army Research During World War II*. Melbourne: Melbourne University Press, 2003.

7 Thompson PE, Olszewski B, Waitz JA. Laboratory Studies On The Repository Antimalarial Activity Of 4,4'-Diacetylaminodiphenylsulfone, Alone And Mixed With Cycloguanil Pamoate (Ci-501). *Am J Trop Med Hyg* 1965;14:343-53.

8 Degowin RL, Eppes RB, Carson PE, Powell RD. The effects of diaphenylsulfone (DDS) against chloroquine-resistant Plasmodium falciparum. *Bull World Health Organ* 1966;34(5):671-81.

9 Laing AB. Treatment of acute falciparum malaria with diaphenylsulfone in North-East Tanzania. *J Trop Med Hyg* 1965;68(10):251-3.

10 Clyde DF. Antimalarial effect of diaphenylsulfone and three sulfonamides among semi-immune Africans. *Am J Trop Med Hyg* 1967;16(1):7-10.

11 Laing AB. Studies on the chemotherapy of malaria. I. The treatment of overt falciparum malaria with potentiating combinations of pyrimethamine and sulphormethoxine or Dapsone in The Gambia. *Trans R Soc Trop Med Hyg* 1970;64(4):562-8.

12 O'Keefe B, Smith FB. *Medicine at War: Medical aspects of Australia's involvement in Southeast Asian conflicts 1950-1972*. St Leonards: Allen & Unwin Pty Ltd, 1994.

13 Black RH. Malaria in the Australian Army in South Vietnam: successful use of a proguanil-Dapsone combination for chemoprophylaxis of chloroquine-resistant falciparum malaria. *Med J Aust* 1973;1(26):1265-70.

14 Lowe J. Studies in sulphone therapy. *Lepr Rev* 1952;23(1):4-29.

15 McKenna W, Chalmers A. Agranulocytosis following Dapsone Therapy. *Br Med J* 1958;1:324.

16 Ognibene AJ. Agranulocytosis due to Dapsone. *Ann Intern Med* 1970;72(4):521-4.

17 Smithurst BA, Robertson I, Naughton MA. Dapsone-induced agranulocytosis complicated by gram-negative septicaemia. *Med J Aust* 1971;1(10):537-9.

18 Stickland JF, Hurdle AD. Agranulocytosis probably due to Dapsone in an infantry soldier. *Med J Aust* 1970;1(19):959-60.

19 Coleman MD. Dapsone-mediated agranulocytosis: risks, possible mechanisms and prevention. *Toxicology* 2001;162(1):53-60.

20 Brinton LA, Hoover R, Jacobson RR, Fraumeni JF, Jr. Cancer mortality among patients with Hansen's disease. *J Natl Cancer Inst* 1984;72(1):109-14.

21 Hironaka K, Mizushima M, Tsuzi C, Makino H. Urinary tract carcinoma in leprosy patients treated with Dapsone for a long period. *Nephron* 1997;76(3):358-9.

22 Grticiute L, Tomatis L. Carcinogenicity of Dapsone of mice and rats. *Int J Cancer* 1980;25(1):123-9.

23 Ackerman Z, Paltiel O. Is malaria chemoprophylaxis also effective against Crohn's disease? *Am J Gastroenterol* 2000;95(1):319-20.

24 Delco F, Sonnenberg A. Military history of patients with inflammatory bowel disease: an epidemiological study among U.S. veterans [see comments]. *American Journal of Gastroenterology* 1998;93(9):1457-62.