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REVIEW ARTICLE

History and Assessment of the War Environment on the Subsequent Health of the Vietnam Veteran

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Abstract

In January 1962, the first Allied combat, combat advisory, and support forces arrived in South Vietnam. By the end of the War, almost 3 million allied personnel had been engaged in this violent Conflict. Six nations provided the Allied Military Forces to support the Republic of South Vietnam from 1965 through March of 1973. The tropical environment posed many challenges to the Allied Military Forces in waging a war against an elusive enemy who had a history of fighting in such an environment. Most Allied combat units spent weeks in the brush enduring the inhospitable environment that included an invisible but deadly enemy. For those soldiers living in outposts or isolated bases or airfields, the constant enemy shelling deprived them of sleep, leaving them exhausted, disoriented, and too often contentious and increasingly depressed. Beyond the possibilities of injury and death during combat, military personnel were exposed to diverse agents and environments that may have affected their health, and thus caused injury and disease while in service or after discharge. Indeed, insect-transmitted diseases and other health related issues accounted for more casualties then did enemy bullets and bombs. Many of those exposures reflected the diverse tasks and functions of military personnel serving in unfamiliar environments associated with combat operations. Fifty health studies of Vietnam veterans by four of the Allied Nations confirmed that with two exceptions, no Vietnam veterans were ever exposed to Agent Orange. What the health studies did confirm was the impact of the "Vietnam Experience" on the long-term health of the men and women who served in the Vietnam War.

Key Words: Vietnam, Vietnam veteran, Allied Forces, vector-borne diseases, veteran health studies, Agent Orange, Vietnam Experience.

Introduction

The United States has always recognized and honored military veterans' service and sacrifices, and appropriately provided compensation and health care for injuries and diseases arising from their service. The United States Department of Veterans Affairs (DVA) identifies Vietnam veterans as men or women who served in the Republic of Vietnam during the period beginning 28 February 1961 and ending May 1975[1]. In 2011, United States Code Title – Veterans' Benefits, Section 101 states "The term "veteran" means a person who served in the active military, naval, or air service, and who was discharged or released from conditions other than dishonorable.

Six nations provided the Allied Military Forces to support the Republic of South Vietnam from 1965 through March of 1973: the United States (US), Australia, New Zealand, Thailand, The Philippines, and The Republic of Korea (ROK)[2]. In addition to the Allied Forces, the "American-Vietnamese War" also included forces from the Republic of South Vietnam, the Viet Cong, and the North Vietnam "People's Army of Vietnam, PAVN"[3,4]. Beyond the possibilities of injury and death during combat, military men and women have always been exposed to diverse agents and environments that may have affected their health, and thus caused injury and disease while in service or after discharge[2]. Many of these exposures reflected the diverse tasks and functions of military personnel serving in unfamiliar environments associated with combat operations.

The deployment of major US and Allied Forces into South Vietnam found them unprepared for the disease-ridden and environmental conditions they encountered. As Allied Forces expanded tropical operations, insect-transmitted diseases and other health related issues accounted for more casualties then did enemy bullets and bombs.

This article is intended to describe the numerous factors that the veterans of the Vietnam War encountered while in combat operations or in support for those operations in South Vietnam. It is important to understand the complexity of the environment in Vietnam and how it dictated the outcome of the Vietnam War. Equally complex was the War itself and the subsequent impact on the long-term physical and mental health of the millions of men and women who served. Thus, it is important to describe the environment and then to identify the nations that provided the military personnel involved in the Vietnam War. When did their participation occur, and how many men and women were sent to support the war, and what were the consequences?

The Physical and Environmental Characteristics of South Vietnam

The physical and environmental characteristics of South Vietnam had a major impact on all facets of Allied Nations' involvement in the war. Fox noted that the environmental setting influenced the defense of hamlets, cities, and military bases as well as the conduct of both air and ground offensive operations[5]. Topography, climate, and vegetation dictated the success of all military and civilian operations during the Vietnam War[5].

Topography

South Vietnam extended more than 1,300 km from its northern border, the Demilitarized Zone (DMZ), to its southern border in the Ca Mau Peninsula, while the width from east to west varied from 50 to 200 km[5]. On the east, the Gulf of Tonkin bordered northern Vietnam, while the South China Sea bordered southern Vietnam. Approximately 60% of Vietnam consisted of relatively high mountains and plateaus rising to elevations of 2,500 m. On the west, the Annamite Chain of mountains formed the northern border between North Vietnam and China, while the southern portion of the Chain formed the borders between South Vietnam, Laos, and Cambodia. Thus, this mountainous terrain provided unlimited infiltration points to almost all the major cities and allied military installations in South Vietnam[6]. The remaining 40% of South Vietnam were lowlands with little or no topographical relief and primarily located in the Ca Mau Peninsula where the land was seldom more than 4-5 m[5,6]. Essentially, the entire countryside of South Vietnam offered cover and concealment to enemy troops while presenting major obstacles to observation, penetration, and movement of friendly ground forces[6].

Climatic Conditions

Moderate temperatures characterized the mountains and plateaus of the Annamite Chain while hot temperatures prevailed throughout the year in the remainder of South Vietnam. The hot temperatures were accompanied by high humidity which physically stressed military personnel and increased the maintenance requirements for all equipment[7]. All regions of South Vietnam experienced heavy rainfall, ranging from less than 200 cm near Saigon (now Ho Chi Minh City) in the south to more than 325 cm near Da Nang in the north. The rainy season for most of South Vietnam occurred from summer through fall (June to November), especially during frequent typhoons. The heavy rainy seasons with accompanying monsoons crippled both friendly and hostile military operations[7].

Vegetative Environment

The 12-month growing season and the abundant rainfall resulted in luxuriant vegetation. Approximately 80% of the Republic of Vietnam had a natural cover of rain forests, mangrove forests, and savanna lands[8]. Diverse tree species comprised the upland forests, with some vegetation attaining a height of 20-40 m in a double or triple canopy jungle[8]. The grasslands and savannas of Vietnam were dominated by tranh grass, brush yen-back, and bamboo species that frequently ascended 2-12 m[8]. The density and height of the vegetation afforded ideal concealment for ambush and infiltration. As Westing noted: "*The forests of Vietnam are a confusing conglomeration of what appears to be primary forests interspersed with a secondary forest in all stages. Moreover, the forests have been subjected over the years and centuries to varying intensities of exploitation for timber, firewood, and miscellaneous products. And, of course, many years of war have left their mark as well, in a variety and obvious and subtle ways*"[8].

Combat Tactical Zones

For purposes of military operations, South Vietnam was divided into four Corps Tactical Zones (CTZ), also called Military Regions, and the Special Capital Zone (Saigon area)[9]. The four CTZ's were identified as I (pronounced "EYE") Corps, II, III, and IV Corps. Each Corps was an administrative and command area for tactical operations[9]. I Corps was in the region nearest North Vietnam and hence, adjacent to the Demilitarized Zone (DMZ). II Corps encompassed the Central Highlands, and III Corps surrounded the Saigon area. IV Corps was in the Ca Mau Peninsula region[9].

Brief Review of the Veterans of the Allied Forces

Allied combat, combat advisory, and support forces first arrived in South Vietnam in January 1962. Over the next 10 years, almost 3 million military personnel from South Korea, Australia, New Zealand, Thailand, the Philippines, and the United States engaged in combat or support operations.

The Allied Forces met an unusually complex challenge in South Vietnam. As Neel noted: "*In addition to the usual problems of waging armed conflict, the assignment in Southeast Asia required superimposing the immensely sophisticated tasks of a modern army upon an underdeveloped environment and adapting them… to fulfill the basic needs of an agrarian population, dealing with the frustrations of antiguerrilla operations, and conducting conventional campaigns against well-trained and determined regular units*"[10].

To understand the tasks, responsibilities, time frame, and numbers of veterans that formed the Allied Forces in Vietnam, it was necessary to describe the contributions that each of the Allied Nations provided. Although there are numerous sources available, the publication by Larson and Collins extensively covered the contributions of the Allied Nations[11].

Republic of South Korea (ROK) Forces

Larson and Collins detailed the history of South Korean government's active role in the Vietnam War[11]. From 11 September 1964 to 23 March 1973 the ROK sent some 350,000 personnel, including ~261,625 combat troops to South Vietnam. The South Korean Army, Marine Corps, Navy, and Air Force all participated as an ally of the United States, with an average of 48,000 troops per year from 1965 through 1970. The ROK reported 5,099 killed and 10,962 injured in the nine years of combat[11].

The first Korean units that arrived in February 1965 included engineers, a medical unit, military police, a navy LST, liaison staff and other support personnel. These elements, totaling 2,416 men were known as the "Dove Unit". Their goal was to assist the Vietnamese armed forces in restoring war-damaged areas in furtherance of Vietnamese pacification efforts. By 29 October 1965, the Republic of Korea's Capital (Tiger) Infantry Division and the 2nd Marine Brigade (Blue Dragon) totaling 18,212 men were sent to South Vietnam. The area of responsibility for the Korean Forces was in II Corps from essentially Phan Rang to Tuy Hoa and supporting areas near Qui Nhon and Phu Cat[11]. In addition to combat troops, South Korea provided ~90,000 non-combat and civilians employed in technical and

civilian tasks within their area of responsibility[11].

Australia Forces

Australia's involvement in the Vietnam War began with a small commitment of 30 military advisors in 1962 and increased over the following decade to a peak of 7,672 Australian personnel[11,12]. From 3 August 1962 to 2 December 1972, Australia deployed 59,732 troops in support of its military commitment to South Vietnam. The Australian government reported 521 killed and more than 3,000 wounded[12].

In August 1964, the Royal Australian Air Force (RAAF) sent a flight of Caribou transport to the port town of Vung Tau, and by December there were almost 200 Australian military personnel in South Vietnam[11,12]. The 1st Battalion, Royal Australian Regiment (1 RAR) arrived in June 1965 aboard the HMAS *Sydney* accompanied by a troop of armored personnel carriers from the 4th/19th Prince of Wales's Light Horse, as well as logistics personnel. In April 1966, the 1st Australian Task Force (1 ATF) was established in Phuoc Tuy Province, based at Nui Dat. For the Australian, the area of responsibility was within III Corps where most combat operations occurred. The Australians established a civic action program to assist the population of Phouc Tuy[12].

New Zealand Forces

The New Zealand contingent in South Vietnam served with the Australians. New Zealand first contributed to the defense of South Vietnam on 20 July 1964 when an engineer platoon and surgical team arrived in Vietnam for use in local civic action projects[11,12]. On 21 July 1965, the 161st Battery, Royal New Zealand Artillery arrived and joined the 1st Australian Task Force in Phuoc Tuy Province. In the Fall of 1966, the New Zealand battalion, the 28th Commonwealth Brigade (Malaysia) was sent for service in South Vietnam. When combined with Australian forces it formed an ANZAC Brigade. On 11 May and 17 December 1967, New Zealand sent two additional companies (V & W Companies) of the Royal New Zealand Infantry Regiment, plus engineer and support troops to South Vietnam. Both rifle companies were also integrated with Australian Forces to form the ANZAC Battalion. This brought the total number of combat troops who served in South Vietnam to 2,347[11,13]. The remaining 1,500 personnel included medical doctors, nurses, and administrative and logistical support personnel. In 1967, New Zealand's medical efforts increased to 43 to support the Dinh Provincial Hospital in Qui Nhon. In December 1972, the military forces of New Zealand returned home. However, the team of the medical staff at Dinh Provincial Hospital remained. This team was evacuated from South Vietnam in March 1975, just before the fall of Saigon. From June 1964 through March 1975, 3,890 personnel were sent to South Vietnam. The New Zealand government reported 37 killed and 187 injured[11,13].

Thailand Forces

The decision of Thailand to support the defense of South Vietnam was a departure from the traditional policy of nonintervention. On 29 September 1964, a sixteen-man Royal Thai Air Force contingent arrived in Vietnam

to assist in flying and maintaining some of the cargo aircraft operated by the South Vietnamese pilots[11]. On 17 February 1966, the Thai Air Force contingent became a subordinate element of the Royal Thai Military Assistance Group with a total of 224 personnel. On 15 July 1967, the deployment of the Royal Thai Army Volunteer Regiment (the Queen's Cobras) began at Camp Bearcat, 16 km southeast of Bien Hoa, III Corps[11]. By October 1967, a regiment of 2,205 Thai troops launched their first large-scale operation. In January 1968, the Cobras were replaced by the Royal Thai Army Expeditionary Division (Black Panthers). The 1968 force totaled 11,266 men and peaked in 1969 with 11,570 men[11]. By December 1971, approximately 40,000 personnel from Thailand had participated in the War in South Vietnam. The Thai government reported 351 killed and 1,358 injured.

Perhaps the greatest contribution by Thailand was the use of its air and naval bases. From 1961 through 1973, the United States Air Force would eventually use 8 airbases in Thailand: Don Muang, Korat, Nakhon Phanom, Nam Phong, Takhli, Udorn, Ubon, and U-Tapao. At the height of the war, some 50,000 American military personnel (mostly Air Force) were stationed throughout Thailand[14].

The Philippine Forces

On 21 July 1964, the Congress of the Philippines approved the dispatch of thirty-four physicians, surgeons, nurses, psychologists, and rural development workers from the armed forces[11]. Four such groups in turn served with dedication during the period 1964-1966. On 16 August 1964, sixteen Philippine Army officers arrived in Vietnam to assist in III Corps advisory effort in psychological warfare and civil affairs[11]. On 28 July 1966, the first element of the Philippine Civic Action Group, Vietnam, arrived and set up their base camp in Tay Ninh. Over the next few months, the Philippine Civic Action Group became firmly and fully established with approximately 1,000 personnel consisting of three civic action teams that initiated medical and dental projects within the surrounding hamlets[11]. While involved primarily in humanitarian aid, the Philippine Civic Action Group were involved in rebuilding roads and on occasion were involved in defense operations. Security of the camp was the responsibility of the Philippine 196th Light Infantry Brigade[11]. By the end of 1966, the Philippines had 2,068 personnel in South Vietnam.

From 1964 to 1973, the Philippines provided more than 6,000 personnel to the Free World Military Assistance Force[11]. Thirteen Filipino personnel were killed in supporting the Civic Action Group. The Philippine embassy in Saigon ceased operations on 29 April 1975. Among its many accomplishments, the Philippine Civic Group in Vietnam resettled 1065 families, distributed 73,750 kgs of food boxes, and sponsored 14 hamlets. Under the Medical Civic Action Program, the Group contributed 724,715 medical missions, 218,609 dental missions, and 35,844 surgical missions[11].

United States Forces

Norman M. Camp, MD, Colonel, Medical Corps, US Army Retired published in 2015 a book titled: *US Army Psychiatry in the Vietnam War: New Challenges in Extended Counterinsurgency Warfare*[15]. Camp recognized that American intervention in South Vietnam in the pursuit of US military objective became a huge undertaking[4,15]. Camp described the challenge: "*The ground war spanned over 8 years and by the time military personnel were withdrawn in 1973, 3.4 million American military men and women had served in the theater (typically a single, 1-year assignment), as well as offshore with the US Navy and at US Air Force bases in Thailand and Guam.*"[15].

Dougherty and Mattson have developed "Vietnam Statistics" of the history of the United States Forces in the Vietnam[15]. War Deaths corrected in 2008 by the National Archives "*Vietnam War US. Military Casualty Statistics*", Washington, DC.

- United States Fatalities: Hostile deaths: 47,434; non-Hostile deaths: 10,786; Total deaths 58,220, including 382 self-inflicted deaths, and 7 Coast Guard deaths.
- Branch of Service: Army 1,407,000 (Fatalities = 38,224); Marines 294,000 (Fatalities = 14,224); Navy 126,000 (Fatalities = 2,559); Air Force 273,000 (Fatalities = 2,586).
- United States Wounded: 303,704; severely disabled: 75,000, including 23,214 totally disabled: 5,283 suffered single limb amputations; 1,081 sustained multiple amputations.
- Total Vietnam-based US Forces, 1959-1973: 2,855,750. The figure 2.86 million likely included Vietnam Veterans who were in country for more than one year[15,16].
- More American casualties were caused by small arms fire or by booby traps and mines than in previous wars, and fewer were caused by artillery and other explosive projectile fragments[15].
- Roughly 20% (~420,000) of troops served in first echelon combat arms, the remainder served in combat support and service support[16].

Review of the Forces of the Republic of Vietnam, North Vietnam, and Viet Cong

Army of the Republic of Vietnam

The Army of the Republic of Vietnam (ARVN) was formally established in 1955[16]. By 1962 significant gains were made in equipping and training in all areas of the Army owing to the buildup of US advisors and operation support forces. At the end of 1967, the Government of South Vietnam had a total of about three quarters of a million men under arms including 341,000 regular forces, i.e., Army, Navy, Marine Corps, Air Force[17]. The Communists' Tet Offensive of February 1968 marked a turning point for the armed forces in terms of morale, manpower, and equipment. Hanoi assured their forces that the ARVN units would desert in droves, but not a single squad went over to the enemy. The enemy lost half of their attacking forces to the ARVN and American troops[17]. The ARVN went on the offensive in mid-1968. By 1969, the Republic of Vietnam, fully mobilized for the first time in two decades of warfare, had trained one out of

every nine citizens to fight the Viet Cong and North Vietnamese Army (NVA). At the same time, the Vietnam Air Force (VNAF) had 63,000 personnel and 2,075 aircraft[16]. At the beginning of 1972, South Vietnam's combat strength was 1,048,000 personnel, with fully equipped 120 infantry battalions, 58 artillery battalions, and 19 battalion-size armored units[17].

The Paris Peace Accords were signed in January 1973. With the departure of all US and Allied Forces in March 1973, both Hanoi and Saigon had concluded that a political settlement to their conflict was impossible and returned to military force to resolve their competition for territory in the South. In the early months of 1974, a resurgent ARVN won a string of victories over their communist opponents[4,16]. By the close of 1974, ARVN units that had been totally dependent on US firepower were increasingly reluctant to close with the enemy[17]. In early 1975, the tide of the war turned in favor of the NVA[10]. The war ended with the fall of Saigon on 30 April 1975. It was estimated that the Republic of Vietnam Armed Forces suffered >250,000 deaths and >1.15 million wounded in action[17].

Communist Vietnam Guerrilla Forces (Viet Cong)

The Geneva Accords of 1954 was intended to "bring about a unification of Viet-Nam." However, neither North Vietnam, officially the Democratic Republic of Vietnam, nor the Republic of Vietnam (RVN) agreed to unification. Beginning in late 1955, the failure to unify the country by referendum led the North Vietnamese People's Army of Vietnam (PAVN) and the South-based Vietnam Guerrilla forces (Viet Cong) to initiate the Second Indochina War[3,4,5]. The Viet Cong was a contraction of a term that meant Vietnamese Communists[17]. Initially the Viet Cong forces were lightly equipped, fast moving, and on foot within South Vietnam. They operated with a primitive road network and proved more than a match for South Vietnamese forces confined to the roads[17]. By 1964, the Viet Cong avoided ARVN units and operated as guerrillas with sabotage, bombing, terrorism, and assassinations as keys to their success.

Supplies for the Viet Cong were limited at the beginning to relatively unsophisticated weapons and war material in limited quantities[17]. Former residents of South Vietnam were indoctrinated by North Vietnam and then formed replacements for Viet Cong units[18]. When the supply of South Vietnamese dwindled, North Vietnamese soldiers became replacements in Viet Cong units. As entire units of the North Vietnamese Army (PAVN) appeared, a transition to the last phase of the war began when NVA units engaged the modern armies of the Allied nations in a full-scale mobile war[17,18].

People's Army of Vietnam (PAVN)

Karnow reported that more than 700,000 personnel from the People's Army of Vietnam (PAVN) died by the capture of Saigon in April 1975[4]. The Vietnamese Government in 1995 released data indicating 1,100,000 NVA and Viet Cong personnel died by the capture of Saigon (Associated Press, 3 April 1995). No data were available on the number of

wounded, but it was likely in the millions. As Ho Chi Minh, the leader of North Vietnam, once said: "You can kill ten of my men for everyone I kill of yours, but even at those odds, you will lose, and I will win"[4].

Encountering the Biological Diversity of the Vietnamese Environment

Biological Diversity and Impact on Troops

Vietnam is ranked 16th among the Earth's most biodiverse countries and is one of the ten richest centers of biodiversity in the world. The waters and lands in and around Vietnam are thought to contain at least 16,000 species of animals and plants[19]. Combat Military Units sometimes spent weeks in the brush and jungles of Vietnam. Their surroundings consisted of heat, humidity, and the presence of biting reptiles, poisonous snakes, leeches, poisonous spiders, giant centipedes and aggressive wasps, all part of the war environment[20].

Vector-Borne and Water-borne Diseases

In the November 1966 edition of ALL HANDS, one of the entomologists assigned by the Navy to the Preventive Medicine Unit (PMU) at Da Nang, South Vietnam stated: "*There are 38 Navymen at PMU Da Nang. In the personal war, the Viet Cong are a nuisance and disease is the enemy. Their greatest worries are the mosquitoes and the rats! The Navymen combat cholera, typhus, plague, encephalitis, dengue, and malaria in the 66,000 square miles of the First Corps area between the 17th parallel and Quang Ngai*"[21].

When information of vector-borne diseases was considered, the emphasis was typically placed upon the medical management of the disease. Military entomologists, however, were concerned with the actual and potential threat posed by disease vectors to US and Allied troops. The military entomologists were faced with an incredibly complex situation of a mixed military and civilian population existing in a basically underdeveloped land with no clear-cut lines or battle zones compounding the difficulty of vector control efforts[22]. Found and identified within Vietnam were 227 generic infectious diseases that were endemic, or potentially endemic to Vietnam[23]. Because of the high humidity and mosquito population, the most common diseases were malaria, chikungunya, and Japanese Encephalitis, all were spread through the bite of an infected mosquito. Because of high rodent populations, and domestic and wild dogs, rabies was common, and care was required to not be infected through bites of these animals. Typhoid fever was found frequently in rural areas where it was spread through unclean food and water or through an infected person. Tuberculosis was one of the most common diseases in Vietnam, especially within the endemic population, e.g., it was estimated that the tuberculosis in Vietnam caused 17,000 Vietnamese deaths annually[22,23].

Filth Flies and Role in Diseases

Filth Flies constituted one of the greatest health hazards in Vietnam. Flies were a major factor in the transmission of several gastro-enteric diseases such as dysentery, cholera, and typhoid fever[24]. It was impossible to estimate the disease transmission that may have been caused by flies in Vietnam, but it

was undoubtedly significant. It was estimated that half of the men developed diarrheal disease within the first two months of service in Vietnam[24]. Infestations of Filth Flies were the most widespread problem encountered at the typical mess hall in Vietnam. This was especially true when field messing facilities had inadequate screening which resulted in unsanitary conditions that resulted in fly-borne contaminated food. Reports from one mess hall stated that the fly infestation was so heavy it was difficult to eat without ingesting one or two. Several factors combined made flies such a large problem. Many of the flies were found breeding in villages near military camps, where they had easy access to animal feces, garbage, and poorly maintained dumps. Garbage collection and land filling, especially at smaller bases, were often inadequate[24].

Control of Malaria and Filth Flies During the Vietnam War

In the Vietnam War, malaria was the most important vector-borne disease[26]. During the first two years of combat-force involvement (1965-1966), more than 10,000 Americans were rendered casualties by this bothersome insect. Control operations in those early years used more than 2.2 million kg DDT[25]. The endemicity of malaria varied widely in time and space probably due to the large mobile parasitic reservoir from the North Vietnamese Army, the Viet Cong, and local populations[25]. In late 1966, the United States Air Force (USAF) modified one of the RANCH HAND UC-123 herbicide-spray planes to an insecticide-spray configuration to counter the spread of the Anopheles mosquito in Operation FLYSWATTER[25]. From March 1967 through February 1972, two UC-123 aircraft dispensed more than 1.76 million L of 95% malathion insecticide. By 1970, routine malathion treatment was being applied to 14 bases and their adjacent cities, and the re-spray interval had been reduced from every fourteen days to every nine days[25]. The frequent anecdotal reports of UC-123s directly spraying troops likely reflected the RANCH HAND mission of frequently spraying insecticide for mosquito control in the hours around dawn and again near sunset[25].

As noted, infestations of Filth Flies were the most widespread problem encountered at the typical mess hall in Vietnam. This was especially true when field messing facilities had inadequate screening which resulted in unsanitary conditions in fly-contaminated food. In January 1966, the Preventive Medicine Units implemented the use of diazinon insecticide, where three times weekly it was sprayed in messes, latrines, showers, and twice weekly in troop tents and quarters[24]. In addition to diazinon, lindane and malathion dust was effective against the flea-borne plague, and the three species of human body lice encountered by US and Allied Forces in Vietnam[24,25]. It should be noted that use restrictions were placed on both diazinon and lindane by the US Environmental Protection Agency in 1988 for their adverse effects on humans.

Medical Support in Vietnam and Subsequent Care Upon Returning Home

To fully understand the challenges facing medical operations in Vietnam, consider that

the nearest off-shore US hospital was in the Philippines and the nearest complete hospital center was in Japan. Thus, the need for self-sufficiency in the zone of operation required a higher ratio of combat service support, including medical support, than was normally provided in more conventional warfare[10]. The 8th Army Field Hospital became operational at Nha Trang in April 1962, and by October 1963, the US Navy opened "Station Hospital Saigon" which consisted of a 100-bed inpatient facility including physicians, dentists, nurses, and hospital corpsmen[20]. Allied Forces began arriving in Vietnam in February 1965 (ROK Forces), March 1965 (US Marines at DaNang), June 1965 (Australian Forces), and in July 1965 (New Zealand Forces)[11]. As the numbers of combat and non-combat troops increased, so did the logistics of materiel, supplies, and the medical support system. Military hospitals, dispensaries and casualty staging units were established to care for the wounded. Military doctors, nurses, and technicians from many outstanding Allied hospitals and medical schools staffed these facilities[10,11] In January 1966, the US Navy Hospital Ship *USS Repose* arrived to support casualties in I Corps. The Hospital Ship *USS Sanctuary* arrived in April 1967 at Da Nang to continue medical support[20].

The cumulative effect of disease was the greatest drain on the strength of Allied combat and support efforts. Disease admissions accounted for just over two of every three hospital admissions in Vietnam in the period 1965 – 1969; while battle injuries and wounds were responsible for one in six admissions[10]. Diseases of military importance included malaria, viral hepatitis, diarrheal diseases, diseases of the skin, FUO (fever of undetermined origin), and venereal disease[10]. The most common venereal disease was gonorrhea, but other infections of the urinary canal was widespread[10]. Selected causes of admissions to hospitals and quarters among active duty US Army personnel in Vietnam is provided in Table 1. Data provided by the Office of the Surgeon General, US Department of Army, Washington, DC.

Table 1. Selected Causes of Admissions to Hospitals and Quarters Among Active-Duty US Army Personnel in Vietnam, 1965-1970. Rate expressed as number of admissions per annum per 1,000 average strengths. *

Cause	1965	1966	1967	1968	1969	1970
Wounded in Action	61.6	74.8	84.1	120.4	87.6	52.9
Injury (except wounded in action)	67.2	75.7	69.1	70.0	63.9	59.9
Malaria	48.5	39.0	30.7	24.7	20.8	22.1
Acute respiratory infections	47.1	32.5	33.4	34.0	31.0	38.8
Skin diseases (includes dermatophytosis)	33.1	28.4	28.3	23.2	18.9	32.9
Neuropsychiatric Conditions	11.7	12.3	10.5	13.3	15.8	25.1
Viral hepatitis	5.7	4.0	7.0	8.6	6.4	7.2
Venereal disease (includes CRO[1])	277.4	281.5	240.5	195.8	199.5	222.9
Venereal disease (excludes CRO[1])	3.6	3.8	2.6	2.2	1.0	1.4
Fever of undetermined origin	42.8	57.2	56.2	56.7	57.7	72.3

[1]CRO: Carded for Record only.

*Source: Health of the Army, May 1966, May 1967, May 1968, May 1969, May 1970, Office of the Surgeon General, United States Army, Washington DC.

As the war raged on, the medical profession was beginning to see the impact on the soldier in other avenues than mortar and booby traps. Substance abuse, infectious diseases, behavior changes associated with the stress of combat, took a toll on the human body and psyche. Jones posited that combat was probably the most intense stressor known to human beings: the imminent, enduring but unpredictable threat to life. The more exposure to combat, the less able to cope with the threat of death or injury[26]. As noted in the death statistics for the United States, there were 382 self-inflicted deaths. To cope with the stress and hardship of war and the fear of loss of self-esteem, deprivation, injury or death, many soldiers asked, "where was the reward to justify the risk and sacrifice?" (15). Soldiers too often recognized that the purposes of the War in Vietnam were understated in terms of killing rather than liberation of territory[15]. Some soldiers satisfied their "longings" through prostitution with the day laborers. Others found refuge from substance abuse including alcohol, which dulled the senses and gave euphoria which had a positive effect on the psyche[15]. Sadly, few branches of the military forces provided treatment/rehabilitation programs but did provide treatment for medical complications. However, as the military Commanders became aware of the nature and extent of the drug problems, they searched for a flexible, nonpunitive response that encouraged drug users to seek professional help in solving their problems, thus aiding them, and at the same time, serving their units in conserving the fighting strength[15].

It is well documented that the Vietnam war had both an emotional and physical effect on the veterans[15,20]. Military nurses who served in the Vietnam war zone were no exception. Nurses, not much older than the soldier they cared for, had to contend with the threat of physical danger, overwhelming casualties, and mental stress, only to be ignored by their government as well as ordinary citizens back home in their countries[27]. As with the male veterans who returned home only to endure failure to receive counseling or rehabilitation, they too struggled for success and meaning in their lives. Most citizens of the Allied nations were unaware that women even served in the war. Volunteerism among nurses assigned to Vietnam gave their reasons as patriotism, wanting to "help the boys over there" and a sense of duty regardless of their own personal view of the political involvement. As with the soldier, patriotism strength failed to see both through the stress of combat and the nature of their jobs[27].

Those men and women who served in the war in South Vietnam returned home not to a "Hero's Welcome", but to chants of "Baby Killers", thanks to the adverse news coverage of the war[27]. The Allied Nation's Veterans Administrations had their challenges in assisting the readjustment of the returning soldiers into society. In 2015, the US Department of Veterans Affairs reported that a third of the US Vietnam veterans were more than 70% disabled, though their disability was not necessarily service connected, and the mean age was 68 years old[28]. Moreover, 80% of the Vietnam veterans were receiving VA health or compensation benefits, with a substantial number of veterans for diseases associated with Agent Orange[27,28].

Health Studies of Allied Vietnam Veterans

Although six Allied Nations provided almost three million personnel to the war in South Vietnam, only four of those initiated health studies of their returning veterans. Even though world-class medical services were available during the conflict, few acknowledged that the long-term impact of war would affect their health and well-being for the rest of their lives. Indeed, with time it was assumed that most diseases and battle injuries associated with war and the stress of combat would be dealt with by Veterans Administrations and would be like those illnesses associated with previous wars. What changed that perception were allegations beginning in 1975 by Vietnam veterans that the defoliants/herbicides, especially Agent Orange, used in Vietnam were the causes of their own diseases and birth defects in their children. Hence, their demands that the US Congress require the Veterans Administration to provide medical care and compensation. Veterans Administrations of the Allied Nations were unprepared to assume responsibilities for health-related diseases allegedly caused by exposures to Agent Orange and its associated toxic contaminant TCDD (2,3,7,8-tetrachlorodibenzo-*p*-dioxin) while on duty in Vietnam.

Finding Resolutions to Vietnam Veterans' Health Concerns from Agent Orange

The perceptions that governments ignored the concerns of Vietnam veterans were not correct. In December 1979, the Federal

Government of the United States established an Interagency Working Group "*To Study the Possible Long-Term Health Effects of the Herbicides and Contaminants*"[29]. In March 1980, the Australian Ministry of Defence requested the preparation "*Military Uses of Pesticides by Australia in South Vietnam*"[12]. By August 1981, President Ronald Reagan elevated the 1979 Committee to "The Agent Orange Working Group", a Cabinet Council level within the Executive Office of the President to initiate, guide, and monitor all Federal Research into the possible adverse health effects of Agent Orange…with a particular focus on the health of Vietnam Veterans[29].

In Australia, the Evatt Report released in 1982 reviewed several studies conducted in Australia but did not at that time recommend additional studies[12]. However, because of continued international concerns both domestically and in Vietnam, the governments of Australia, New Zealand, and the Republic of South Korea followed the United States in conducting numerous health studies of their Vietnam veterans[30]. At least 24 morbidity studies and 19 mortality studies of Vietnam veterans have been published by the United States, Australia, New Zealand, and South Korea. Most of these studies were intended to validate veteran's allegations that exposure to the dioxin (TCDD) in Agent Orange was responsible for their illnesses[30].

The Fallacies of Exposure Claims to the Contaminant TCDD

In 1994, the Institute of Medicine viewed the determination of exposure of military personnel who served in Vietnam as "***perhaps the greatest challenge in the study of health effects associated with herbicides and TCDD***"[31]. To address that challenge, it was important to first determine the quantity of TCDD likely contained in the tactical herbicides sprayed in Vietnam. The second challenge was in assessing the potential exposure of Vietnam veterans to the available TCDD.

Analytical data from archived samples of Agent Orange and the other TCDD containing herbicides, indicated that between 130 and 144 kg of TCDD were sprayed on the jungles and mangrove forests of Vietnam during the period January 1962-April 1970. Data compiled by the National Research Council of the National Academy Sciences and completed in 1972 (HERBS TAPE) indicated that 96-98% Agent Orange and hence the contaminant was sprayed by RANCH HAND aircraft on jungle and mangrove vegetation. The remaining 2-4% were sprayed by the US Army Chemical Corps outside base perimeters or spilled as "hot spots" where tactical herbicide drums were stored[32]. Studies of Agent Orange and the contaminant TCDD spread on leaves indicated that photodegradation of the TCDD occurred within 24-48 h. However, once the Agent Orange TCDD was spilled on soils (hot spots), it bound tightly to the soil and could persist for decades[33]. This evidence of environmental fate and poor bioavailability of the TCDD from spraying Agent Orange suggested that little or no exposure occurred to the veterans who served in Vietnam.

Epidemiologist have described four basic ways to assess potential veteran exposure to the TCDD in Agent Orange. The first approach was to use historical contemporary military records, especially those records for conducting spray missions. Young, Cecil and Guilmartin concluded that the historical information demonstrated that spraying occurred only when friendly forces were not located in target area[34]. A second approach was to use the results of modeling studies of human exposure to TCDD. This approach was to use validated models and methods routinely employed by regulatory agencies. A third approach was developed by Columbia University in 2003 titled "*A geographic Information System for Characterizing Exposure to Agent Orange and Other Herbicides in Vietnam*"[35]. This GIS method was based on a relational database system that integrated the extensive data from the HERBS records of RANCH HAND that could be used to generate a quantitative exposure opportunity index for veterans at varying distances from RANCH HAND spray missions. Criticism of this method suggested that precise individual-level exposure assessments for ground troops in Vietnam was impossible. The last approach was to determine the TCDD content in the blood serum of alleged environmentally exposed veterans who conducted military operations in areas heavily sprayed with Agent Orange.

This last method was consistent with a study conducted by Centers for Disease Control and Prevention (CDC) of veterans allegedly receiving environmental exposures of TCDD. The 1988 study compared the blood serum TCDD levels in 646 ground combat troops who served in Vietnam in an area heavily sprayed with Agent Orange, against 97 veterans who did not serve in Vietnam. The concentration of TCDD levels in both groups were nearly identical, ~ 4 parts per trillion (ppt)[36].

Health Studies by Conducted by United States Agencies

Three agencies of the United States government conducted studies of Vietnam veterans. The CDC conducted three studies of US Army Vietnam veterans; the Department of Veterans Affairs conducted morbidity and mortality studies of veterans who had served in either the Marines or Army, including members of the Army Chemical Corps; and the United States Air Force long-term health studies of the veterans who served in Operation RANCH HAND. A critical review of the health studies of the four nations was conducted and published by Young, 2022[30].

CDC Studies of Vietnam Veterans

The first large epidemiologic study conducted by CDC was a 30-year post-service mortality study of a cohort of 9,324 male US Army veterans who had served in Vietnam matched with 8,989 male non-Vietnam veterans. The results: Vietnam veterans continued to experience higher mortality than non-Vietnam veterans from unintentional poisoning and drug-related causes. Death rates from disease-related conditions, including cancers and circulatory diseases, did not differ between Vietnam veterans and their peers, despite the increasing age of the cohort (mean age, 53) and the longer follow-up

(average, 30 years)[36]. CDC also conducted population-based case-control studies examining the risk among Vietnam Veterans for Non-Hodgkin's lymphoma (NHL), Soft tissue and other sarcomas (STS), and Hodgkin's disease (HD), nasal, nasopharyngeal cancers, and primary liver cancers among Vietnam veterans. These studies found no association between NHL, STS, HD, nasal carcinomas, nasopharyngeal cancer, or liver cancer between either Vietnam service or self-reported Agent Orange exposures[30]. The last major study by CDC was the Vietnam Experience Study. This was a multidimensional assessment of health of a random sample of 7,924 Vietnam veterans and 7,364 non-Vietnam veterans. The results of the medical and laboratory examinations showed few objective differences in physical health between the two groups. The rates of birth defects among their children were also similar. However, Vietnam veterans were found to have increased depression, anxiety, and PTSD[30].

Department of Veterans Affairs (DVA) Epidemiologic Studies

DVA conducted six morbidity case-control studies of Vietnam veterans[30]. These case-control studies of Vietnam veterans did not provide evidence of an association between risk for STS, HD, NHL, testicular cancer, or lung cancer. The odds ratio for the risk of cancer did not significantly vary according to branch of service, calendar year of service, region of service in Vietnam or location of units relative to recorded sprayed areas by RANCH HAND or the US Army Chemical Corps[30]. DVA also conducted four proportional mortality ratio (PMR) studies, and one retrospective cohort mortality study of Vietnam veterans, three studies of US Army Chemical Corps in Vietnam, three studies of Women Vietnam veterans, and two studies of PTSD and risks of traumatic deaths among Vietnam veterans[30].

To briefly summarize: The mortality studies of Vietnam veterans suggested an increased risk of deaths compared to non-Vietnam veterans especially due to motor vehicle accidents, and PTSD-related suicides. Studies of Army and Marine veterans found inconsistencies for cancers such as lung cancer, laryngeal cancer, NHL, and skin cancers. Studies of women Vietnam veterans found increases in pancreatic cancer and risk of birth defects in their children. However, these studies found no evidence of exposure to Agent Orange/TCDD. The only studies where TCDD measurements were established were with the US Army Chemical Corps (mean of 4.3 ppt and a range of 0.50 – 85.8 ppt; n = 357). Although the levels of TCDD were low, the investigators concluded that the odds ratios for diabetes, heart disease, hypertension, and chronic respiratory conditions were significantly elevated (P> 0.05). However, Chemical Corps personnel were significantly exposed to other chemicals and environmental sources, not just herbicides[30].

Unable to establish a relationship between Agent Orange exposure and health effects, DVA researchers from 2014-2021 conducted four studies of veterans who had registered in the Agent Orange Registry, a data base of more than 780,000 veterans who self-

reported exposures with no verification. These studies offered no consistent or convincing evidence of a causal relationship between exposure to Agent Orange/TCDD, and prostate, skin, or hepatocellular cancers, and dementia diagnosis[30].

United States Air Force Epidemiologic Study

The Air Force Health Study (AFHS) was a twenty-year epidemiologic retrospective study of the 1,261 men of Operation RANCH HAND. TCDD testing of the blood serum of these men found levels ranging from 10 to 618 ppt with a mean of 12.4 ppt; n = 888. The strength of the AFHS was in matching 5:1 the RANCH HAND cohort with a comparison cohort of 19,109 men who flew C-130 aircraft vs the C-123 RANCH HAND aircraft in Vietnam. During the six examinations over 20 years, the AFHS investigated 300 health endpoints. AFHS did not provide evidence of disease in the RANCH HAND veterans by their elevated levels of exposure to Agent Orange or its associated TCDD[37].

Australian and New Zealand Epidemiologic Studies

As previously noted, the 1982 Evatt Royal Commission Report on the "*Use and Effects of Chemical Agents on Australian Personnel in Vietnam*" was presented to the Parliament of Australia[12]. The Royal Commission Report not only rejected the claims of their Vietnam veterans but noted that there was no evidence to show that their health had suffered because of chemical exposures in Vietnam[12] A similar report was prepared and received by the Parliament of New Zealand in 2004[13]. This latter report acknowledged that New Zealand Vietnam veterans were exposed to a toxic environment, but only recommended that the Veterans Affairs Department monitor the health of their Vietnam veterans[13].

Australian Health Studies of Vietnam Veterans

Preliminary data on selected cancers were collected in 2000 from a postal survey of 40,030 Australian Vietnam veterans of selected cancers and other conditions including health of their children[38]. This survey promoted the Department of Veterans Affairs to select a cohort of 6,842 veterans for further study[38]. Despite limitations, the study found that there was an apparent increase in melanoma, prostate cancer, NHL, and eye cancer[38]. In 2004, the Department did a cancer incidence report on all surviving 59,187 Vietnam veterans. The cancer incidence of Australian Vietnam veterans was 18% higher than the Australian male community and there was evidence of an increase in prostate and lung cancer, and in HD[39]. These results promoted the Centre for Health Policy, University of Melbourne in 2015 to conduct a retrospective cohort of 60,228 Vietnam veterans and 82,877 military personnel not deployed to Vietnam[40]. The objective of this study was to examine patterns and trends in long-term disability among combat veterans and to relate disability to aspects of wartime experience. The findings were that veterans with service more than 1 year were 2.5 times more likely to have a disability than those who served less than 1 year. Moreover, long-term effects of deployment into military conflicts were substantial, and the likelihood of war-related

disabilities was associated with service history[40]. These were not Agent Orange studies.

New Zealand Studies of Vietnam Veterans

In 2013, the University of Otago and the Centre for Military and Veterans Health, University of Queensland conducted a cohort mortality study to determine the patterns and cancer incidence in 2,783 New Zealand Vietnam veterans compared with New Zealand National rates[41]. When compared with National rates, all cancer mortality were significantly reduced, and all cancer incidences were not significantly increased. Cancers of the head and neck and oral cavity, pharynx and larynx were however significantly increased. Surprisingly, an increased incidence of chronic lymphatic leukemia (CCL) was noted. The pattern of mortality and cancer incidence was consistent with smoking and the healthy soldier effect. New Zealand veterans were the only Vietnam veterans reporting an increase in CCL[41]. These were not Agent Orange studies.

Republic of Korea Vietnam Veterans Studies

The Korean Vietnam Veterans Health Studies were initiated in 2012 by the Asan Medical Center, Gangneung Asan Hospital, Seoul, South Korea[42]. There were three studies conducted by Professor Sang-Wook Yi and his team of researchers. The first study found that the cancer incidence in Vietnam veterans were significantly lower than the general male population. The overall cancer incidence was lower in officers than enlisted soldiers. This latter cohort did experience higher incidence in T-cell lymphoma, prostate, colon, lung, bladder, and kidney cancers than the general population. The second and third studies incorporated the Colombia University's Geographical Information System based on proximity to RANCH HAND missions. The second study used a cohort of 111,726 Korean Vietnam veterans and the risk of disease prevalence. The Study concluded that using the same GIS model, veterans exposed to Agent Orange decades earlier had an increase in morbidity from various diseases[42]. This prompted the investigators to use the same exposure model but to do so by increasing the cohort to 180,639 Korean Vietnam veterans and examining the mortality data. Again, the investigators concluded that Agent Orange/TCDD may have accounted for an increase in mortality from various diseases even decades after exposure[30]. A follow-up study was a clinical study of outcomes of Korean Vietnam veterans with acute coronary syndrome (who self-selected Agent Orange exposure as the cause). The rate of major adverse cardiovascular events had no relationship with exposure to Agent Orange TCDD. After having used the GIS model, the investigators conducted a blood serum test for TCDD. Korean Vietnam veterans had a range of TCDD values from 0.66 to 1.30 ppt (n = 1224), while non-Vietnam veterans had a mean TCDD level of 0.30 ppt (n = 154). The Korean scientists concluded that Korean Vietnam veterans had minimal exposure to Agent Orange and its associated TCDD[30].

Conclusion

As the Vietnam War concluded with the Paris Peace Accords in 1973, the Allied Forces returned to their respective countries. As

Vietnam veterans returned it was assumed that most diseases and battle injuries associated with war and the stress of combat would be dealt with by Veterans Administrations and would be like those illnesses associated with previous wars. In the early 1980s, the legacy of Agent Orange became such a concern of the Vietnam veterans and the public that four of the Allied Nations instituted health studies of their Vietnam veteran to assess if exposure to Agent Orange and its associated dioxin contaminant, TCDD, had an impact on their health. Except for two studies, the scientists that conducted the fifty mortality, morbidity, and TCDD studies in the United States, Australia, New Zealand, and South Korea, were unable to confirm that their veterans were even exposed to the Agent Orange or its TCDD. The twenty-year United States Air Force Health Study confirmed exposure to TCDD, but the study did not provide evidence of diseases in the RANCH HAND veterans caused by their elevated levels of exposure. The second study was the US Army Chemical Corps veterans who sprayed herbicides, other pesticides, and other chemicals, e.g., napalm in Vietnam. Although the levels of TCDD were low, the investigators concluded that the odds ratios for diabetes, heart disease, hypertension, and chronic respiratory conditions were significantly elevated (P> 0.05). The health studies by all four nations provided evidence that it was the "Vietnam Experience" that impacted the long-term health of the Vietnam Veteran.

The current policies of the United States Department of Veterans Affairs are inconsistent with the science[43]. The scientific community has conducted extensive research supporting compensation and health based on the impact of Vietnam experience[43,44]. There are sufficient data on the lack of exposure to Agent Orange and TCDD to question the current polices of the Department and the intent of Congress[43,44]. Less than half of the 2.6 million US Vietnam veterans receive NO compensation and health care for long-term diseases attributed to their service in Vietnam, because those diseases are not recognized as associated with Agent Orange exposure. The implementation of the 1991 Agent Orange Act was established to provide compensation and health for only those diseases allegedly associated with Agent Orange exposure, but now that policy provides compensation and health care for Vietnam-era veterans who were not exposed to Agent Orange but were in service on Guam, Okinawa, Thailand, and on the DMZ in South Vietnam[45]. The question that should have been ask of government was "why artificially focus on Agent Orange?' It would have been fairer to all Vietnam veterans with a program of Vietnam experience that provides benefits and compensation for all Vietnam veterans. All our Vietnam veterans deserve the best possible health care the nations could provide and the recognition they are entitled to for having served in Vietnam.

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Conflicts of Interest
None

The Authors Military Careers and War Time Experience
Alvin Lee Young, PhD, retired as Colonel from the United States Air Force in 1989. He was a Professor of Environmental Toxicology at the United States Air Force Academy, The University of Oklahoma, the USAF School of Aerospace Medicine, the USAF Environmental Health Laboratory, and the Argonne National Laboratory. At the request of the US Department of Defense, Dr. Young conducted workshops on Agent Orange and TCDD in 2005 and 2007 in Vietnam, and in 2011 in South Korea. He was assigned as an Air Force Officer to the Veterans Administration, 1982-1984, to assist in developing the programs of the newly established "Agent Orange Project Office."
Lynda V. Alexander, RN, BA, MS, ARNP, retired as a Lieutenant Colonel from the United States Air Force in 1987. Lt Col Alexander had been assigned to the 21st Casualty Staging Flight at Tan Son Nhut Airbase in Vietnam during 1968-1969, a period when US and Allied casualties peaked. The CSF was a 24 h casualty-in and casualty-out operation for transport out of country. Post-Vietnam years she continued to interact with Vietnam veterans, always sharing experiences knowing that she would understand the trauma and emotional release that it afforded.

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