

COMMITTEE RECOMMENDATIONS

As part of its charge, the committee was asked to make recommendations concerning the need, if any, for additional scientific studies to resolve uncertainties concerning the health effects of the chemicals of interest sprayed in Vietnam: 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and its contaminant 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), picloram, and cacodylic acid. This chapter summarizes the committee's recommendations.

Although great strides have been made over the last several years in understanding the health effects of exposure to the chemicals of interest and in elucidating the mechanisms underlying them, gaps in our knowledge remain. The scope of potential research on the chemicals is wide, and what follows here is not an exhaustive list of future research that might have value. There are many additional opportunities for progress in such subjects as toxicology, exposure assessment, the conduct of continuing or additional epidemiologic studies, and systematic and comprehensive integration of existing data that have not been explicitly noted here. It is the committee's conviction, however, that work needs to be undertaken promptly, particularly to address questions regarding several health outcomes, most urgently tonsil cancer, melanoma, paternally mediated transgenerational effects, and PD.

- **The current definition of *Vietnam service* is not supported by existing data.**

The evidence that this committee has reviewed makes limiting *Vietnam service* to those who set foot on Vietnamese soil seem inappropriate. The ongoing series of hearings and appeals in the US Court of Appeals for Veterans Claims (*Haas v. Nicholson*) reflect the controversy. As discussed in Chapter 3, there is little reason to believe that exposure of US military personnel to the herbicides sprayed in Vietnam was limited to those who actually set foot in the Republic of Vietnam. Having reviewed the Australian report (NRCET, 2002) on the fate of TCDD when seawater is distilled to produce drinking water, the committee is convinced that this use of seawater would provide a feasible route of exposure of personnel in the Blue Water Navy, which might have been supplemented by drift from herbicide spraying.

The epidemiologic evidence itself supports a broader definition of *Vietnam service* to serve as a surrogate for presumed exposure to Agent Orange or other herbicides sprayed in Vietnam. For instance, the Centers for Disease Control and Prevention (CDC, 1990) study of selected cancers in Vietnam veterans found that the risk of the "classic AO cancer" NHL was highest and most significant in Blue Water Navy veterans. More recently, the Air Force Health Study (AFHS) has demonstrated that TCDD concentrations in Vietnam-era veterans deployed to Southeast Asia, not just the "Vietnam veteran" Ranch Hand subjects, are generally higher than US background concentrations (although notably lower than in Ranch Hand sprayers themselves).



The present committee notes that all previous VAO committees have considered information on naval Vietnam veterans to pertain to possible Agent Orange exposure when evaluating the full spectrum of health outcomes. The present committee finds that exposure assignment to be appropriate. No new studies considered in this update contained Navy-specific information, but such information has been factored into the evolving conclusions of VAO committees.

Given the available evidence, the committee recommends that members of the Blue Water Navy should not be excluded from the set of Vietnam-era veterans with presumed herbicide exposure.

- **VA should evaluate possibilities for studying health outcomes in Vietnam-era veterans by using the existing administrative and health-services databases.**

The original VAO committee recommended that the Department of Defense (DOD) and VA identify Vietnam service in the computerized index of records. Linking that information with the VA electronic medical-record and associated administrative databases, such as discharge-diagnosis and pharmacy-use records, should make it possible to assemble epidemiologic information on common health conditions for evaluation of possible associations with military service in Vietnam.

Particular attention should be paid to the feasibility of conducting epidemiologic studies of conditions that have been noted to be of special interest but on which the current evidence is inadequate or insufficient to determine whether there is an association with herbicide exposure (such as tonsil and breast cancers, melanoma, amyotrophic lateral sclerosis, lupus, ischemic heart disease, and stroke). For very uncommon health outcomes, a case-control design would probably be most appropriate.

Although applications for compensation and appeals constitute a nonrepresentative, self-selected sample that is influenced by which conditions are already judged to be service-related, an effort to use existing VA information should include a more systematic review of the distribution of health outcomes in the database.

To evaluate whether Vietnam veterans actually have experienced an increase in tonsil cancer, the next logical step would be for VA to identify the veterans with tonsil cancer that are already in the system and examine the biopsy results to classify the form (origin) of tonsil cancer better. Given the low incidence of this rare condition, a typical epidemiologic study in the general population would not be useful. Determining whether the lymphatic nature of the tonsil plays a role in a substantial proportion of tonsil cancers would guide planning of the next steps for research.

A portion of the Neurotoxin Exposure Treatment Research Program (NETRP) is related to the pathogenesis and etiology of several conditions, including PD, and has been funded since 1997. Originally housed in the US Army Military

The report of the VAO committee (IOM, 1994) proposed further work on exposure reconstruction and development of a model that could be used to categorize exposures of ground troops. The committee cautioned that serum TCDD measurements not be regarded as a “gold standard” for exposure, that is, as a fully accurate measure of herbicide exposure. Recent efforts to develop exposure-reconstruction models for US Vietnam veterans are discussed later in this chapter.

One other effort to reconstruct exposure has been reported by researchers in the Republic of Korea (Kim et al., 2001, 2003). They developed an exposure index for Korean military personnel who served in Vietnam. The exposure index was based on herbicide-spray patterns in military regions in which Korean personnel served during 1964–1973, time–location data on the military units stationed in Vietnam, and an exposure score derived from self-reported activities during service. The researchers were not successful in an attempt to validate their exposure index with serum dioxin measurements.

Exposure of Personnel Who Had Offshore Vietnam Service

US Navy riverine units are known to have used herbicides while patrolling inland waterways (IOM, 1994; Zumwalt, 1993), and it is generally acknowledged that estuarine waters became contaminated with herbicides and dioxin as a result of shoreline spraying and runoff from spraying on land. Thus, military personnel who did not serve on land were among those exposed to the chemicals during the Vietnam conflict. A particular concern for the personnel has been possible contamination of drinking water. Most vessels serving offshore but within the territorial limits of the Republic of Vietnam converted seawater to drinking water through distillation.

Higher than expected mortality among Royal Australian Navy Vietnam veterans prompted a study of potable-water contamination on ships offshore during the Vietnam conflict (Mueller et al., 2001, 2002). Specifically, the study investigated the potential for naval personnel to ingest TCDD and cacodylic acid in drinking water. The study focused on the evaporative distillation process that was used to produce potable water from surrounding estuarine waters. The study found that codistillation of dioxins was observable in all experiments conducted and that distillation increased the concentration of dioxins in the distillate compared with the concentration in the source water. The study also found that dimethylarsenic acid did not codistill to a great extent during evaporation and concluded that drinking water on ships was unlikely to have been contaminated with this herbicide. In a follow-up discussion of the study with its authors, it was noted that vessels would take up water for distillation as close to shore as possible to minimize salt content (Wells, 2006). On the basis of that study and other evidence, the Australian Department of Veterans Affairs determined that Royal Australian Navy personnel who served offshore were exposed to dioxins

that resulted from herbicide spraying in Vietnam even if they did not go ashore during their tour of duty (ADVA, 2005).

The current committee engaged Steven Hawthorne as a consultant to review the Mueller et al. (2002) publication and to comment generally on the ability of organic compounds to codistill during the production of potable water. Hawthorne is an environmental chemist at the University of North Dakota's Energy and Environmental Research Center and has specific expertise in the study of organic emissions from water (Hawthorne et al., 1985). He affirmed the findings of the Australian study, citing Henry's law for an explanation of how contaminants with low water solubility would evaporate from water and noting that the distillation process would enhance the process by adding heat and reducing pressure (SB Hawthorne, University of North Dakota Energy Research Center, personal communication on October 23, 2008). No measurements of dioxin concentrations in seawater were collected during the Vietnam conflict, so it is not possible to ascertain the extent to which drinking water on US vessels may have been contaminated through distillation processes. However, it seems likely that vessels with such distillation processes that traveled near land or even at some distance from river deltas would periodically collect water that contained dioxin. Thus, a presumption of exposure of military personnel serving on those vessels is not unreasonable.

In its charge to the original VAO committee, the Department of Veterans Affairs asked the committee to include military personnel who served in inland waterways, offshore of the Republic of Vietnam, and in the airspace above the Republic of Vietnam. A presumption of exposure to Agent Orange and other herbicides used as defoliant applied to each of those groups as well as to those who served on land. In light of the findings of the Australian study regarding potential drinking-water contamination and those serving offshore, the presumption seems well founded.

EXPOSURE OF THE VIETNAMESE POPULATION

Studies of exposure to herbicides among the residents of South Vietnam have compared nonexposed residents of the South with residents of the North (Constable and Hatch, 1985). Other studies have attempted to identify wives of veterans of North Vietnam who served in South Vietnam. Records of herbicide spraying have been used to refine exposure measurements, comparing people who lived in sprayed villages in the South with those living in unsprayed villages. In some studies, village residents were considered exposed if a herbicide mission had passed within 10 km of the village center (Dai et al., 1990). Other criteria for classifying exposure included length of residence in a sprayed area and the number of times the area reportedly had been sprayed.

A small number of studies have provided information on TCDD concentrations in Vietnamese civilians exposed during the war (Schechter et al., 1986, 2002,