



Blue Water Navy Vietnam Veterans and Agent Orange Exposure

Committee on Blue Water Navy Vietnam Veterans and Agent Orange Exposure; Institute of Medicine

ISBN: 0-309-16248-3, 158 pages, 6 x 9, (2011)

This free PDF was downloaded from:

<http://www.nap.edu/catalog/13026.html>

Visit the [National Academies Press](http://www.nap.edu) online, the authoritative source for all books from the [National Academy of Sciences](http://www.nap.edu), the [National Academy of Engineering](http://www.nap.edu), the [Institute of Medicine](http://www.nap.edu), and the [National Research Council](http://www.nap.edu):

- Download hundreds of free books in PDF
- Read thousands of books online, free
- Sign up to be notified when new books are published
- Purchase printed books
- Purchase PDFs
- Explore with our innovative research tools

Thank you for downloading this free PDF. If you have comments, questions or just want more information about the books published by the National Academies Press, you may contact our customer service department toll-free at 888-624-8373, [visit us online](http://www.nap.edu), or send an email to comments@nap.edu.

This free book plus thousands more books are available at <http://www.nap.edu>.

Copyright © National Academy of Sciences. Permission is granted for this material to be shared for noncommercial, educational purposes, provided that this notice appears on the reproduced materials, the Web address of the online, full authoritative version is retained, and copies are not altered. To disseminate otherwise or to republish requires written permission from the National Academies Press.

Shipboard environments are influenced by ventilation systems that run throughout the entire ship. The systems have the potential to spread airborne materials collected at one site to other sites if not properly designed and maintained. The potential spread of occupationally produced airborne materials could have a serious influence on the health of shipboard personnel.

FATE AND TRANSPORT OF AGENT ORANGE AND TCDD IN THE VIETNAMESE ENVIRONMENT

Potential exposure of Blue Water Navy personnel to Agent Orange and its contaminant TCDD is related to the fate of these chemicals in the Vietnamese environment. The committee considered using a mathematical model to estimate likely TCDD concentrations based on Agent Orange inputs to the environment. All models require a host of input parameter values such as standard physical-chemical properties of TCDD, characteristics of the Vietnamese environment, and chemical- and environment-specific parameter values such as rates of TCDD degradation in the Vietnamese environment and seasonally and spatially specific knowledge of air and water movement. The committee found that input data and, importantly, data with which to evaluate model performance, were not available. Furthermore, tremendous uncertainty would accompany any attempt to model overall TCDD fate by scaling up from modeling emissions from individual spray paths for which data are available, to estimate TCDD concentrations along hundreds of miles of coastline and in coastal waters. Thus, the committee concluded that using models to estimate likely concentrations of TCDD in the Vietnamese environment to which Blue Water Navy personnel might be exposed would not be possible because of the lack of data with which to parameterize the model. Even if a model could be parameterized, data are not available to evaluate model performance. Without evaluating the model, the uncertainty of model results would be far too great and thus, the committee could not be confident that such results were reasonable.

The committee explored the variability and uncertainty of many of the input parameters that would be needed for assessing the fate and transport of TCDD in the Vietnamese environment. The goal of this exercise was to assess qualitatively the fate of TCDD released during the Vietnam War. The discussion acknowledges the importance of location-specific factors that mediate the chemical fate and transport, notably the tropical climate and geography of Vietnam. Since most of the literature on chemical fate of dioxins originates from temperate areas such as Europe and North America that differ significantly from the Vietnamese environment, the committee was mindful of these differences as its understanding of the fate TCDD in Vietnam was developed.

It has been estimated that 87% of the Agent Orange sprayed in Vietnam reached the forest canopy, while the remaining 13% drifted and was subject to atmospheric transport or degradation processes. The committee assumed that Agent Orange that did not reach the forest canopy or soils could enter the water either by direct spraying over waterways or deposition of spray drift or indirectly via land runoff.

The committee concluded that Agent Orange and TCDD would have entered waterways from riverbank spraying (although this was a small fraction of the total Agent Orange applied in Vietnam) or as runoff from soil, particularly in the Mekong delta area that was heavily sprayed and that experienced frequent flooding. This river loading would be highly diluted by river flows. A considerable fraction of particles and humic material to which TCDD would absorb, would be expected to have settled in the delta region or estuaries.

TCDD would enter the coastal marine water from river discharge and spray drift. The contribution of TCDD to marine waters from these transport routes would be reduced to a great extent by two main processes: dilution in river water and dispersion in air, as well as by further dilution in the coastal waters. Given the paucity of monitoring information and the variability and uncertainty in the fate and transport information on TCDD as it pertains to Vietnam, the committee concluded that it is not possible to estimate the likely concentrations of TCDD in marine waters and air at the time of Blue Water Navy deployment.

EXPOSURE ROUTES AND MECHANISMS

The committee was tasked with comparing exposure among three military populations that served in Vietnam: troops on the ground, Brown Water Navy personnel, and Blue Water Navy personnel. The approach used by the committee to address the task of comparing exposure among the three populations was to evaluate possible pathways of exposure of each of the three populations (termed exposure opportunities) and to consider whether it is plausible that people in these groups could have been exposed, via these pathways, to Agent Orange–associated TCDD.

The committee determined that any assessment of exposure must be qualitative rather than quantitative. Qualitative estimates should be informed by knowledge of the fate and transport of the chemicals of interest and by documented or anecdotal information on potential pathways of exposure.

The committee recognized that in addition to possible differences in exposure potential among populations, there are differences among individuals. Even ground troops or Navy personnel with similar job descriptions would be expected to have experienced varied exposure because of differences in environmental concentrations, personal activities, and associated intake characteristics (such as exposure duration, food and water ingestion rates, inhalation rate, and body weight). The committee recognizes that there may be individuals in a given group whose experiences do not accord with the descriptions given in this report. It should be noted that ground troops and Brown and Blue Water Navy personnel also included an unknown fraction of personnel who were remote from spraying operations and possibly had no opportunity for exposure.

The committee identified several plausible exposure pathways and routes of exposure to Agent Orange–associated TCDD in the three populations. Plausible pathways and routes of exposure of Blue Water Navy personnel to Agent Orange–associated TCDD include inhalation and dermal contact with aerosols from spraying operations that occurred at or near the coast when Blue Water Navy ships were nearby, contact with marine water, and uses of potable water prepared from distilled marine water.

Large US Navy ships—such as aircraft carriers, cruisers, and destroyers—had their own potable-water supply and distribution systems that included water-treatment processes. Potable water is produced by distillation of marine water. Although the committee was told that Blue Water Navy ships did not typically make potable water within 12 miles of shore, the committee was also told that in exceptional circumstances a ship might take up water for distillation while relatively close to the coastline. The issue of distillation of marine water is important because of the finding by the committee that prepared the 2008 *VAO* update that Blue Water Navy veterans could have been exposed to TCDD via contaminated potable water. The Australian Department of Veterans Affairs determined that Royal Australian Navy personnel who served offshore were exposed to Agent Orange-associated TCDD in Vietnam because the distillation systems aboard

the ships were thought to be able to concentrate TCDD in source water into the potable water during the evaporative process. This committee used a theoretical model to corroborate the findings of the experimental Australian study that found substantial codistillation of TCDD during production of potable water with a batch distillation unit that was commonly used in Blue Water Navy vessels. If Agent Orange–associated TCDD was present in the marine water, distilled potable water would be a plausible pathway of exposure.

LONG-TERM ADVERSE HEALTH EFFECTS

The long-term adverse health effects associated with exposure to dioxins have been studied in a variety of populations, including Vietnam veterans. The biennial IOM *VAO* reports have reviewed epidemiologic studies of Vietnam veterans, occupational studies, and population studies in an effort to determine whether Vietnam veterans are at increased risk for adverse health effects from exposure to Agent Orange during the Vietnam War. A few of the studies include veterans who served in the Blue Water Navy in Vietnam, but most of the studies do not distinguish Navy veterans, let alone Blue Water Navy veterans, from other Vietnam-veteran populations.

In addition to reviewing previous *VAO* reports, the committee heard from a number of veterans and is aware that many veterans attribute their current illnesses to exposure to Agent Orange in Vietnam. The committee valued these accounts for descriptive purposes but did not have a way to use that information in its study because without a relevant control population to demonstrate that the veterans' diseases are attributable to Agent Orange–associated TCDD exposure and not other factors, the exact causes of their illnesses cannot be determined.

For Navy veterans as a whole, the Australian cancer-incidence study indicated a significantly higher risk of lung cancer (although the study did not adjust for smoking) and prostatic cancer, both of which are currently recognized as TCDD-related malignancies. The Australian study also found significant associations with melanoma and colon cancer, neither of which has been categorized as TCDD-related by the IOM or the VA. The Australian mortality study corroborated the Australian cancer-incidence findings on lung cancer and melanoma. However, both Australian reports found significantly lower risk of NHL, one of the first cancers the IOM found to be associated with Agent Orange exposure. One study found neither higher nor lower risk of NHL in Vietnam-era Navy veterans. In contrast, the Centers for Disease Control and Prevention Selected Cancers Study found a significantly higher prevalence of NHL in US Blue Water Navy Vietnam veterans. Finally, in a small study, testicular cancer was associated with service in the Navy (although the Blue Water Navy was not specified) in Vietnam veterans, although testicular cancer has not been found by the IOM to be associated with Agent Orange exposure.

Overall, the committee concludes that because of the small number of studies and their limitations, there is no consistent evidence to suggest that Blue Water Navy Vietnam veterans were at higher *or* lower risk for cancer or other long-term adverse health effects associated with Agent Orange exposure than shore-based veterans, Brown Water Navy veterans, or Vietnam veterans in other branches of service.

CONCLUSIONS

Since the 1970s, IOM committees and other groups have attempted to reconstruct Vietnam veterans' potential exposure to Agent Orange and TCDD. Given the lack of exposure data on ground troops and the limited knowledge about exposure among Blue Water Navy veterans, the committee concluded that it was not possible to make quantitative exposure comparisons among the three military populations of interest to the VA. Therefore, the committee evaluated the *plausibility* of exposure of the three populations to Agent Orange and TCDD via various mechanisms and routes.

The committee recognized that considerable variability exists in the potential for TCDD exposure by Blue Water Navy personnel, ground troops, and Brown Water Navy personnel. Focusing on the Blue Water Navy, some personnel may have spent their entire tour of duty on aircraft carriers that never came close to the Vietnamese coast, whereas others served on ships that may have spent many days as close as 1 mile offshore. In addition to the variability in the location of Blue Water Navy personnel, there is extensive uncertainty regarding the experiences of individual sailors on those ships (for example, whether they were on a ship when it was near the Vietnamese coast, whether they went swimming, and whether they ate local food from Vietnam or Vietnamese waters).

The committee concluded that, qualitatively, ground troops and Brown Water Navy veterans had more plausible pathways of exposure (that is, there was a greater number of plausible exposure mechanisms) to Agent Orange–associated TCDD than did Blue Water Navy veterans. One exposure mechanism is specific to Blue Water Navy ships: possible TCDD contamination of potable water from onboard distillation plants. The committee's assessment corroborates the Australian finding that in experiments simulating the water-distillation system used on Navy ships the system had the potential to enrich TCDD concentrations from the feed water to the distilled potable water. However, without information on the TCDD concentrations in the marine feed water, it is impossible to determine whether Blue Water Navy personnel were exposed to Agent Orange–associated TCDD via ingestion, dermal contact, or inhalation of potable water.

The committee was unable to state with certainty that Blue Water Navy personnel *were or were not* exposed to Agent Orange and its associated TCDD. Owing to a lack of data on environmental concentrations of Agent Orange and Agent Orange–associated TCDD and an inability to reconstruct likely concentrations, as well as the dearth of information about relative exposures among the ground troops and Brown Water Navy personnel and Blue Water Navy personnel, it is impossible to compare actual exposures across these three populations. Furthermore, the committee concludes that because of the small number of studies and their limitations, there is no consistent evidence to suggest that Blue Water Navy Vietnam veterans were at higher or lower risk for cancer or other long-term adverse health effects associated with Agent Orange exposure than shore-based veterans, Brown Water Navy veterans, or Vietnam veterans in other branches of service.

The committee's judgment is that exposure of Blue Water Navy Vietnam veterans to Agent Orange-associated TCDD cannot reasonably be determined.