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MILITARY TOXIC EXPOSURES: THE HUMAN CONSEQUENCES OF WAR

HEARING

BEFORE THE

COMMITTEE ON VETERANS' AFFAIRS UNITED STATES SENATE

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WEDNESDAY, MARCH 10, 2021

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MILITARY TOXIC EXPOSURES: THE HUMAN CONSEQUENCES OF WAR

WEDNESDAY, MARCH 10, 2021

U.S. SENATE,
COMMITTEE ON VETERANS' AFFAIRS,
Washington, DC.

The Committee met, pursuant to notice, at 3:08 p.m., in room SD-G50, Dirksen Senate Office Building, Hon. Jon Tester, Chairman of the Committee, presiding.

Present: Senators Tester, Brown, Blumenthal, Manchin, Sinema, Hassan, Moran, Boozman, Rounds, Tillis, Blackburn, and Tuberville

OPENING STATEMENT OF CHAIRMAN TESTER

Chairman TESTER. I call this meeting of the Senate Veterans' Affairs Committee to order. Good afternoon and thank you for joining us today, to hear from veterans, medical experts, and veteran services organizations about the long-term health consequences of war.

When we promise to train and equip our servicemembers so that they are ready for war we also promised to care for them as veterans after they return home. We now know that not all injuries are visible, not all reveal themselves immediately, and not all are due entirely to enemy action. Some conditions can take years to manifest, and too often they are the results of our own government's actions, whether it is spraying the battlefield with Agent Orange to remove hiding spots from an enemy, or using burn pits to dispose of waste. No matter the cause, our promise remains the same—fight for us and we will fight for you.

In the last Congress we made tremendous strides in keeping that promise. We are bringing relief to Vietnam-era veterans dealing with hypothyroidism, bladder cancer, and Parkinsonism. But this fight is not over. Current science shows even greater evidence of an association between Agent Orange and other conditions like hypertension and MGUS.

So here we are again. Relief for these conditions is long overdue. We have wasted literally decades deliberating over science and wrestling with bureaucratic red tape. We should not delay any longer.

Even as Vietnam-era veterans struggled with the decades-long effects of Agent Orange, the next generation of brave men and women were fighting new wars in Iraq, Afghanistan, and Syria. There, many servicemembers were exposed to open burn pits to dispose of waste. Many returned with obviously damaged lungs

while others continue to fall ill today, in some instances, a decade or more after coming home.

As a government, we did not learn our lesson after Vietnam. Our veterans are still fighting red tape to get health care and benefits that they have earned and are needed. Because of the VA's inaction on behalf of Agent Orange-exposed veterans, Congress has acted to provide benefits for Blue Water Navy Vietnam veterans and Korean War veterans who served on the DMZ. And most recently, we worked to add three presumptive conditions in keeping with the scientific evidence provided by the National Academies.

But that is not an ideal solution. We must develop a comprehensive system that is able to quickly deliver care and benefits to veterans as science develops around currently known and newly discovered exposures, without congressional action.

This system must prioritize serving veterans' urgent needs and delivering life-saving care. Only then will we begin to fulfill the promises we have made to care for those who have sacrificed so much on our behalf. Otherwise, we will continue to hear from vets like Jeff O'Malley, a Vietnam War veteran, and William Thompson, Iraq War veteran, about how their government is failing to address the cost of war associated with their services to this Nation. And I ask my colleagues, listen closely today to their testimony.

I also want to thank our other witnesses for joining us today to help us better grasp the scientific evidence that should inform our decisionmaking, and the impact of these exposures on the veteran community at large.

With that I turn it over to you, Senator Moran.

OPENING STATEMENT OF SENATOR MORAN

Senator MORAN. Chairman, thank you. Thank you for the things you said in your opening Statement and thank you for organizing this hearing.

Good afternoon, everyone. Thank you to all of our witnesses for joining us today. I certainly appreciate what Senator Tester had to say and I look forward to learning more from this hearing about how we can do our jobs, as a committee, better.

In modern history, we have tragically seen that exposure to toxic substances have become an increasingly common component of armed conflicts and warfare. Such exposure is not always known or considered at the time, and too often the long-term health effects are not understood. For too long, veterans have been exposed to toxic substances during the course of their military service, and they have faced overwhelming barriers to get the VA care and services that they deserve. The burden of proof is a challenge for veterans, and we must find ways to bridge that gap.

I was encouraged by bipartisan legislation passed by this Committee last Congress to address these issues. As a result of our work, we have seen several new laws on the books directing research and covering more of our veterans from Vietnam and Korean War, but our work, of course, is far from done.

Over the years, Congress has responded to multiple cohorts of veterans affected by exposure to mustard gas, lewisite during the 1940's, iodizing radiation from nuclear test sites during the cold war, Agent Orange during the Vietnam War, Gulf War illnesses

during Desert Storm, and now burn pits and other toxins during the global war on terror. The varied approaches to addressing these different exposures in the past demonstrates the need to establish a fair, transparent, and sustainable process going forward. Decades of patchwork fixes show a clear need for significant improvement.

As we consider ways to improve how our country cares for those who became ill through exposure to these substances during their military service, we must and should listen to those who have suffered the negative health outcomes. I think all of my Committee colleagues would agree when I say that the voices of veterans are always those we want to hear, the ones we listen to most. Theirs are the voices we hold in highest regard in helping us do our jobs.

It is also crucial that we hear from the scientific and medical communities. Care works best when there is a reliable system in place for the VA to first be provided with necessary scientific research on which to inform timely decision on whether to establish presumptions of service connection for certain conditions. Veterans deserve an enduring framework to identify, research, and address cases of toxic exposure in a timely manner. The need for reform has existed far too long, and veterans cannot be forced to wait decades for care any longer.

In our last hearing, I remember hearing one of the VSO representatives indicate that he had been working on his case, his own case, really for his lifetime, since he departed from the service, with still no satisfaction.

I am interested to hear from our witnesses today on how best we, on this Committee, can achieve the outcomes that we all want for veterans. I look forward to hearing from each of you today and to continue to work to make certain that all veterans suffering negative health consequences from their service receive the care they deserve.

And I yield back to the Chairman.

Chairman TESTER. Thank you, Senator Moran. Thank you for your comments. I certainly appreciate them very much.

We are going to have six witnesses today. The first four are going to give their testimony virtually. And so we will start out with Anthony Szema, who is an MD, a Clinical Associate Professor of Medicine in Pulmonary and Critical Care, Zucker School of Medicine at Hofstra/Northwell. You have the floor, Dr. Szema.

STATEMENT OF ANTHONY SZEMA

Dr. SZEMA. Can you hear me?

Chairman TESTER. We can.

Dr. SZEMA. The 2003 invasion of Iraq, and resulting conflicts in the Middle East, have led to the longest, prolonged military deployment in U.S. history. One million troops have served in Iraq and Afghanistan during the eighteen-year conflict. Now, 26 percent of the 150,000 military personnel in the U.S. VA Burn Pits Registry self-report new onset respiratory symptoms, beginning in military theater. We noted 14.5 percent of New York-based soldiers developed new onset asthma post deployment.

Airborne hazards may account for new onset lung diseases. Soldiers inhale dust storms, pollen, mold, and improvised explosive devices leading to shock waves in the lung with metal deposition.

Blast overpressure from shock waves induces traumatic brain injury and post-traumatic stress disorder, PTSD, which, by itself, is linked to asthma.

Most importantly, these troops are also exposed to burning trash in open air "burn pits." Uniformly, trash was lit on fire with jet fuel, JP–8, which contains benzene, a carcinogen. Burn pits are in open air without an incinerator, and burn at low heat. This generates more particles than incinerators. More particles are associated with increased risk of all-cause mortality, or death, cardiovascular diseases such as heart attacks and strokes, and lung diseases, including asthma, COPD, and among these soldiers we have seen, as you will hear from Will today, constrictive bronchiolitis and lung scarring, or fibrosis. In fact, we can detect burned particles in the lungs of these troops.

Military personnel often do not have pre-deployment lung testing other than a two-mile run time. If a soldier returns with a cardiopulmonary exercise test that is 80 percent predicted post-deployment, which would be considered otherwise within normal limits, if in fact pre-deployment that soldier was 120 percent predicted, then this is a significant decrease.

We propose NIH-or NIOSH-funded monitoring centers of excellence for affected patients, analogous to World Trade Center Monitoring Programs, since in the greater New York area, for instance, most veterans are not seen in the VA since they exceed income limits, are young with full-time civilian jobs, and have commercial health insurance. We envision centers studying basic animal models, investigating therapeutic agents, clinically monitoring patients longitudinally, like the World Trade Center Monitoring Programs, and conducting clinical trials.

The consultative National VA War-Related Illness injury centers are few and excellent, but neither monitor patients nor perform biopsies. We conceptually agree with 2020 bipartisan bill H.R.8261 in the House and S. 4572 in the Senate which proposed to grant presumption of medical claims for all troops who were deployed to Iraq and Afghanistan since 2003. We agree with the concept that President Biden should propose for consideration in his first 100 days, presumption of care for war fighters with subsets of lung diseases post-deployment.

Even in 2020, 77 percent of veterans requesting compensation and pension medical exams for maladies beginning in Iraq and Afghanistan are denied benefits. The American Thoracic Society, in 2019, argued for more research. The National Academy of Medicine, in addition, argued for investigation of biomarkers and predeployment pulmonary diagnostic monitoring. So we urge further research on returning soldiers.

Not only should we honor the dead who have made the ultimate sacrifice in war, but we also should provide care for the living: brave women and men who sacrificed their health for freedom.

Senator MORAN. [Presiding.] Doctor, thank you very much. I am now going to recognize one of your patients, William Thompson, who is an Iraq War veteran, who served in the Army, who has had both lungs transplanted twice due to his exposure in Iraq. Mr. Thompson?

STATEMENT OF WILLIAM THOMPSON

Mr. THOMPSON. Yes, sir. Can you hear me?

Chairman TESTER. Yes, sir.

Mr. THOMPSON. Thank you for hearing us today and thank you for having us. My name is retired Staff Sergeant William Thompson. I served 23 years, 3 months and 11 days in the United States Army and the West Virginia Army National Guard. I have deployed twice with the West Virginia Army National Guard to Iraq. During my last deployment, I was stationed at Camp Stryker at the Victory complex.

My symptoms of frequent coughing started around September 2009, while in Iraq, in which my doctors and physician assistants treated me for what they thought were allergies. I returned to Fort Stewart, Georgia, and after I mentioned to the doctors I was having frequent cough, they did a chest x-ray that revealed bilateral pneumonia. They treated me with antibiotics and sent me home to West Virginia to followup with my PCP in 1 week.

After a week, I followed up with my doctor, Dr. Remines, and he discovered, after more testing, that I had pulmonary fibrosis with nodules, and Stated that my lungs looked like an "80-year-old coal miner's lungs." He referred me to Walter Reed Army Medical Center pulmonary department where I was treated by Dr. Jacob Collins for 6 months. He admitted me to the Warrior Transition Unit at Walter Reed and after 6 months of testing, which included an open lung biopsy, I was informed that I had titanium, magnesium, and iron, in addition to silica, in my lungs. They diagnosed me with hypersensitivity pneumonitis and pulmonary fibrosis.

I gained 60 pounds from the high amounts of steroids I was on daily. Because my lung disease was chronic, I was referred to Inova Fairfax Hospital by Walter Reed and was told I would most likely need a lung transplant in the future. I have been seen by Inova Fairfax Hospital Lung Transplant Clinic from February 2011 to the present time. During that time, I have been on oxygen levels as high as 10 liters continuously. On June 6, 2012, I received a double lung transplant. After 2 months of followups, I was able to return home and start pulmonary rehab.

The first year was a good year. I took all precautions and followed all the orders that were instructed by my doctors. Despite this, over the next 3 years, I went through periods of lung rejection and infections and decreased oxygen levels. I was back on oxygen again, and on March 9, 2016, I underwent another double lung transplant. Unfortunately, they are more susceptible to complications than other organ transplants since the lungs are exposed to everything from the environment.

My life and my family's life have changed since I returned home in 2010. I have to wear a mask in highly populated areas. I know wearing a mask is typical these days, but I have been wearing one since 2012. It is hard to hang out with my kids only to tell them "I cannot do that."

"Daddy, let's go skiing." Sorry, kids, I cannot do that.

"Daddy, let's go swimming." Sorry, kids, I cannot do that.

"Daddy, can you give me a piggyback ride?" Sorry, Ava, I cannot do that.

"Daddy, let's go fishing." Sorry, Ethan, I cannot do that because of the bacteria on the fish.

"Dad let's go to the beach." Sorry, kids, I cannot do that because of the bacteria in the water and the sun with my transplant medications makes me more prone to skin cancers.

Speaking of skin cancers, I am currently battling trigeminal neuralgia after having a skin cancer removed from my left cheek that aggravated my trigeminal nerve. This is a very painful and debilitating condition that is also known as the "suicide disease" and is known to be one of the most painful disorders known to medicine. It causes sudden shock-like pain in my face that lasts from minutes to hours at a time. Because of this disorder, I have added numerous medications to my previously very large daily pill regimen.

I do not feel like a man anymore because my wife has had to take many roles from me. There are so many things that I can no longer do.

I am a warrior of the United States of America. I gave my lungs for my country. The toxins in the air from the burn pits and the dust in Iraq has changed my life. I am glad to be alive and home when so many did not make it home. My illness and injuries are different. I have heard so many times from the VA "We do not know how to treat you," or "You do not qualify or fit the parameters for benefits." I have been denied TSGLI because the Army does not think having a lung transplant is a "traumatic event." Burn pits should be recognized and acknowledged as an incident of war.

Luckily, we found the group, Semper Fi of America Fund, who works with veterans and provided the funds to make my bathroom ADA accessible. Since then, the VA has helped me with one housing HISA grant, but only after being denied several times.

My injuries and illnesses are different from other more common injuries from Iraq and because of that it took the VA 3 years to provide me with an air purifier in my home to keep my home free of allergens and dust. They also denied help in removing carpet from my home that was instructed by my doctors, so we had to pay for this ourselves. We have also taken out a loan to build a workout area in my home where I can work out and continue my pulmonary rehab during times of my illness or times when cold or flu season is at its peak. Although I was 100 percent service connected through the Army and VA, I do not qualify to receive my retirement until age 60 because my injuries were not "combat related." I may not live to be age 60—I turn 50 this year.

Every day for me is a battle I continue to fight. I still have to battle infections and try to keep my body healthy from lung rejection. I still have to fight secondary problems related to my transplant. Hopefully, after hearing my story, it will bring awareness for not only me but others who are battling the same or similar injuries related to burn pit exposures from Iraq or Afghanistan.

Thank you allowing me to share my story.

Senator MORAN. Mr. Thompson, thank you for your compelling story, your testimony. Senator Tester, Chairman Tester, has turned and I now turn the gavel back to him.

Chairman TESTER. [Presiding.] Thank you, Ranking Member Moran. Next up, virtually again, is Karl Kelsey, who is an MD,

Professor of Epidemiology, Pathology and Laboratory Medicine at Brown University. Dr. Kelsey, you have the floor.

STATEMENT OF KARL KELSEY

Dr. KELSEY. Good afternoon, Chairman Tester, Ranking Member Moran, members of the Committee. My name is Karl Kelsey. I am a professor at Brown University and a physician. I am here today in my capacity as a member of a committee formed by the National Academy of Sciences, Engineering, and Medicine to assess the evidence of an association between exposure to Agent Orange and other herbicides used in the Vietnam War and adverse health effects.

As many of you know, the National Academies have a long history of advising the Federal Government on the health effects of military services. I have served on committees that produced 4 of the 12 reports in the Veterans and Agent Orange series. Today I will discuss Update 11, which was released in 2018, and I will focus my testimony on the epidemiologic evidence of an association between exposure to herbicides and hypertension.

From 1962 to 1971, the U.S. military sprayed herbicides over Vietnam for tactical purposes. The most used chemical mixture sprayed was Agent Orange, which, as you know, is contaminated with TCDD, which is the most toxic form of dioxin.

The National Academies committees classified a strength of evidence regarding the association between exposure to the chemicals of interest and health outcomes into four categories: sufficient, limited or suggested, inadequate or insufficient, and no association. As mandated by the Agent Orange Act, the distinction among the categories are based on statistical association, not strictly on causality.

Our Update 11 committee concluded that the available medical and scientific information constitutes significantly sufficient evidence of an association between exposure to at least one of the chemicals of interest and hypertension. The strongest conclusion regarding a potential increase in the incidence of hypertension came from studies that controlled for many risk factors associated with hypertension.

Our committee reviewed six new studies of exposure to chemicals of interest and hypertension that have been published since the previous update. Five of these had one or more significant study design deficiencies that would not be considered adequate to change the level of association individually.

Our decision to change the classification from "limited or suggested" to "sufficient evidence" of an association was really motivated by a 2016 paper, authored by VA researchers, Yasmin Cypel and colleagues. These investigators conducted a study of Vietnam veterans in the Army Chemical Corps, the ACC. The study was characterized by a large sample size, appropriate controls, and validated health endpoints. The statistical analysis was robust, they used State-of-the-art methods, they adjusted for relevant confounders, and included several levels of exposure, herbicide sprayers and non-sprayers, and Vietnam-deployed and non-deployed veterans.

The study clearly showed that self-reported hypertension rates were the highest among the military personnel with the greatest opportunity for exposure to the chemicals of interest. Among the Vietnam-deployed veterans, there was a statistically significant elevated association between the odds of hypertension through sprayers versus non-sprayers, and this remained after adjusting for potential confounders.

Similarly, for the veterans who did not deploy to Vietnam, self-reported hypertension was significantly elevated among the sprayers compared with the non-sprayers.

Among those with serum TCCD levels available, self-reported herbicide spray status had high agreement with the measured levels. The highest mean TCCD level was observed among the sprayers deployed to Vietnam, and the lowest level was found for the non-Vietnam non-sprayers. This would be expected with a significant dose response association.

Likewise, there was high agreement between self-reported hypertension and in-person blood pressure measurements in medical records review that was done for a subsample of the participants. As I said, the analysis controlled for the important risk factors for hypertension.

So a major strength of this analysis was also using non-Vietnam-deployed ACC veterans as a comparison group, because they are really quite similar to the members of the study group. Although it is important to note the exact types and quantities of the various chemicals that these ACC veterans were possibly exposed to during the Vietnam War are unknown, and may include chemicals other than herbicides, there is a statistically significant support for an association between herbicide exposure and self-reported, physician-diagnosed hypertension.

I should also mention recent biological mechanistic research was reviewed by the committee and it also showed evidence for dioxin's impact on hypertension via effects on gene expression, vascular function, lipid glucose metabolism, and so on. When the totality of evidence was considered, our committee found that this body of literature constituted sufficient evidence of an association.

I thank you for the opportunity to testify, and I am happy to answer any questions that you may have.

Chairman TESTER. Thank you, Dr. Kelsey. I appreciate your testimony also, and there will be questions here as soon as we hear from all the witnesses.

Next we have Jeffrey O'Malley. Jeffrey is a Vietnam veteran who served in the Army, currently living with drug-resistant hypertension and kidney cancer. Jeff, the floor is yours.

STATEMENT OF JEFFREY O'MALLEY

Mr. O'MALLEY. Chairman Tester, Ranking Member Moran, honorable members of the Committee, my name is Jeff O'Malley, and I am honored to be asked to participate in today's hearing of the Committee. I would like to note the date as having special significance for me, as it is exactly 50 years from the date that I boarded the plane for Vietnam, March 10, 1971. The experiences I had during my tour, and those of all my comrades, have stayed with us for all these years.

I signed a 4-year enlistment in June 1969, committing to assignment with the Army Security Agency, and with the expectation that I would probably be sent to language school. I completed basic and was sent to the Defense Language Institute, Southwest at Biggs Field, Ft. Bliss for the 47-week Vietnamese language course. After graduation, we were sent to an electronics courses and then Vietnam. During language school and the electronics course, our top secret security clearances were completed.

I served from March 1971 to late February 1972, as a voice intercept linguist for the Army Security Agency. Except for a few day trips, I worked at the 8th Radio Research Field Station south of Hue. The work was important, and, at times, stressful, but the unit was well run and efficient, earning two unit citations during my tour.

I returned to the United States in late 1972, pending my discharge, and received my discharge and I returned to Houston, and re-entered civilian life.

Over the years, I used the GI Bill to go to college, and worked in various positions in retail, including a career of about 15 years as a loss prevention executive in Texas and Louisiana. After that career, I had various jobs, and many of them were of a contract nature and did not have benefits, including health insurance, but I was in generally good health.

In the summer of 2008, I was offered a permanent position with an alternative school in the area, with a raise and full benefits. It was due to begin on September 1, 2008, and I accepted. As is fairly common in southeast Texas in late summer, a hurricane arose in the Gulf, knocking out power for a 2-week period, and I was not able to start at the beginning of the school year. I took the time, during my downtime, to try to find a primary care physician with my new Blue Cross Blue Shield insurance, and I found one that was open and had power, and went to meet the doctor.

Since the nurse had not been scheduled to be there that day, the doctor did the normal nurse things for me—height, weight, and took my blood pressure and history. When she took my blood pressure she got very quiet, and then she said, "I think I am going to take it again," and she did, and she said, "Mr. O'Malley, I am your primary care physician now. I am going to give you a pill and you are going to sit in the lobby for an hour, and we are going to see if we can get it to come down, because it is really high."

I went and sat in the lobby. I think I had a Klonopin pill. And in an hour she took it again and she said, "I am going to give you another pill and we are going to wait another hour." During that time she scheduled me for blood work and a chest x-ray, and various other tests, and it was determined that my blood pressure, at that point, when she first read it, was 210/140. She had indicated that she had never seen blood pressure that high in the office. She had seen it in the emergency room when someone was having a stroke.

She needed to find out why I had that high blood pressure, but she gave me a prescription and I started work. The prescription did not work for me. I regularly had my blood pressure taken and was sent home because it was too high. Eventually I went to a cardiologist who got my prescription right, but he still needed to find out

why, so he was going to send me for a CT scan. Sometimes the kidney arteries can cause high blood pressure.

After the CT scan it was determined that I also had kidney cancer. It was stage I, because I had no symptoms of anything when I went to the doctor. I did lose my kidney at that point, but I have not ever had radiation or chemo.

After about 6 months I tried to figure out why was it, since I lost my kidney, why was I still taking blood pressure medicine? And the doctor had to tell me, "Mr. O'Malley, we found your kidney cancer but we still do not know why you have high blood pressure."

So I take four medications for my high blood pressure, and it is under control when I take my medication but it causes me a great deal of fatigue. It took me a while to recover, and in the long run I lost the job that I had, I lost the Blue Cross insurance that I had, and that is when I came to the VA.

A fellow veteran of mine, who trained and served with me, Dan Ferguson, from Toledo, Ohio, asked me, on a trip to Toledo, what kind of cancer I had and whether it was an Agent Orange presumptive disease. It was not. We went to his VSO to try to determine if there was anything that could be done, and he indicated to me that I should start watching the research on hypertension, and I did so.

When Dr. Shulkin, in 2017, in November, announced that he had made a decision about the pending presumptives, I tried to figure out what that decision actually was, and I could not. I did everything that the VA asked me to do. I called the White House Veterans Hotline; they could not give me an answer. Four times I called them and they never did anything, were able to tell me.

Eventually, I filed a FOIA and was denied, and then appealed, and then I won, and then I started getting documents from the VA. I, over a period of time, grew frustrated with the process, and provided those documents to the press and to Congress, which indicated some of the flaws in the way presumptives are decided.

My health, when my blood pressure is controlled, has been pretty good, but my stamina has meant that I, at my age, I was not able to find meaningful employment after that.

The opportunity to testify about this before the Committee and to support the effort to understand the ongoing problems resulting from the use of Agent Orange is greatly appreciated, and I look forward to any questions you may have.

Chairman TESTER. Thank you, Mr. O'Malley, and I want to thank Mr. Thompson and Drs. Kelsey and Szema for their testimony. Now we will hear from Shane Liermann, Deputy National Legislative Director for the DAV. Shane, you are up.

STATEMENT OF SHANE LIERMANN

Mr. LIERMANN. Thank you. Chairman Tester, Ranking Member Moran, and members of the Committee, on behalf of DAV's more than 1 million members who have wartime service-related wounds, injuries, diseases, and illnesses, we thank you for the opportunity to appear before you today to discuss the human costs of toxic exposure.

When our service men and women are subjected to toxins and environmental hazard, our sense of duty to them must be height-

ened, as many of the illnesses and diseases due to these exposures may not be identified for years, even decades, after they have completed their service. As noted in our written testimony, this is compounded by the time it takes for VA to concede these exposures and to scientifically associate presumptive diseases. In many instances, it has taken decades to provide these veterans access to benefits and health care they have earned.

Although Congress established a presumptive process and diseases for Vietnam veterans exposed to Agent Orange in 1991, it is now over 40 years—excuse me, over 50 years since the end of that conflict and they are still fighting for inclusion of presumptive diseases. We thank you, Chairman Tester and Ranking Member Moran, and the whole committee for getting bladder cancer, hypothyroidism, and Parkinsonism added to the presumptive list.

However, Vietnam veterans are still facing obstacles. For example, Theodore Kalagian, my wife's uncle, honorably served the United States Army in Vietnam and is still fighting VA for his benefits. He was diagnosed with bladder cancer in 2005, and was denied VA benefits in 2007. Subsequently, he developed ischemic heart disease, diabetes, and prostate cancer, all presumptive to his Agent Orange exposure. Last, he also has hypertension, which VA died and has refused to add as a presumptive disease, despite, as noted, the National Academies determined there is a significant, positive, scientific association to Agent Orange exposure.

There are millions of other veterans exposed to toxins that VA has not conceded or established presumptions for, such as burn pits. Ms. Ashley McNorrill was deployed to Iraq as an Army JAG officer stationed at Camp Victory in Baghdad in 2005. She was exposed to toxins emitted from burn pits that she noted were only a few feet from their chow hall. After service, Ms. McNorrill and her husband tried to start a family but were unable to conceive due to what they were told was endometriosis, which required a hysterectomy. After they adopted two small twin boys, she decided to have the hysterectomy, and during the surgery was discovered that she had stage IV appendiceal cancer, a rare form of the disease occurring only in one or two cases out of a million.

After years of VA claims and appeals, with the assistance of a DAV service officer in South Carolina, she was awarded total and permanent VA disability benefits. The grant of benefits was based on her private medical opinion, linking her burn pit exposure to the development of her rare disease. Shortly after this victory, she succumbed to her burn pit-related cancer and left her husband and two young sons behind.

This is why S.437, the Veterans Burn Pit Exposure Recognition Act, is so important. The bill would concede exposure to burn pits for anyone who served in a recognized country and concede their exposure to the specific list of toxins already accepted by VA. It would also guarantee a VA exam and medical opinion, if required, to grant the claim. This bill would not provide presumptive diseases. Instead, it will remove barriers for direct service connection.

We thank Senator Sullivan and Senator Manchin for introducing this legislation, and it could have granted Ms. McNorrill benefits much sooner and allowed her to enjoy more time with her family in her final years, instead of fighting the VA.

Mr. Chairman, we are at a critical crossroads of the horrific cost of toxic exposures and a presumptive process that is wildly inconsistent and lacking flexibility moving forward. It is clear that veterans need a way of establishing service connection for diseases related to toxins now, and not wait for the scientific community or VA's bureaucratic processes. We recommend reforms and a new framework which should include access to VA health care, a concession of exposure, and time-required actions by the VA.

This concludes my testimony, and I am pleased to answer any questions you may have.

Chairman TESTER. Thank you, Mr. Liermann. I appreciate your testimony. Next up we have Aleks Morosky, Government Affairs Specialist for the Wounded Warrior Project. Aleks?

STATEMENT OF ALEKS MOROSKY

Mr. MOROSKY. Chairman Tester, Ranking Member Moran, and members of the Committee, thank you for the opportunity to testify on Wounded Warrior Project's efforts to assist veterans who have been exposed to toxic substances during their military service.

For nearly 20 years, a significant number of post-9/11 veterans have been exposed to contaminants such as burn pits, toxic fragments, radiation, and other hazardous materials found on deployments to countries like Iraq, Afghanistan, and elsewhere. As an organization dedicated to connect, serve, and empower our Nation's post-9/11 wounded ill and injured veterans, we are firmly committed to addressing their toxic wounds with the same urgency that we address the physical and invisible wounds of war.

Results from our 2020 Annual Warrior Survey confirm the scope of the issue, but the warrior story cannot be told with data alone. To better illustrate the challenges that exposed warriors face, both with their illnesses and with access to VA health care and benefits, I would like to tell you about a warrior named Scott Evans.

Scott was a Marine. He deployed twice to Afghanistan as a combat engineer and as a dog handler. He served at the Battle of Marjah, and like so many, he also suffered exposure to open-air burn pits during his deployments. He says burn pits were sometimes even used as a training area where they taught military dogs to sniff out munitions among burning waste.

In 2012, Scott was honorably discharged and immediately began working a full-time civilian job. Like many hard-charging veterans, since he felt he suffered no significant disabilities from his service, he never filed a claim or enrolled in VA medical care.

Then suddenly, in the spring of 2020, at the age of 32, Scott started experiencing severe abdominal pain and rapid weight loss. At that point, he attempted to enroll for care at his local VA, but learned that he was not eligible since he never filed a disability claim and was beyond the 5-year enhanced eligibility period for combat veterans.

In July 2020, a friend who had served with Scott reached out to Wounded Warrior Project to see if we could help, and by this time Scott had incurred about $20,000 in medical bills, seeking a diagnosis and treatment for his condition. It was obvious at that time that Scott was critically ill.

Our Wounded Warrior Project teammate convinced Scott to return with him to the VA hospital. When he got there, the emergency room doctors immediately recognized the seriousness of the situation but needed Scott to visit Eligibility before they could provide further care. Eligibility told him once again that he was ineligible to until he was service connected.

After Scott and his wife left the room a teammate told the clerk that Scott was an uninsured, terminal cancer patient with multiple combat tours and an honorable discharge. After looking again at Scott's combat service record, the clerk relented and Scott was enrolled at VA.

Since then, Scott has received compassionate, life-prolonging care for his illness, eventually diagnosed as terminal pancreatic cancer. Scott has since been granted service connection, but we are immensely grateful that our teammate was able to obtain care for him when he did. Sadly, a veteran without such an advocate may have been turned away indefinitely.

I spoke to Scott and his wife on the phone yesterday. They told me that while the care has been good at VA since he has been enrolled, it is a terrible feeling to wonder whether the mass on his pancreas may have been operable if it was caught a few months sooner, when he first tried to seek care. They also told me that they know that there are other veterans who are in the same situation as them, and they only hope that sharing their story will lead to improvements in the system for others, even though Scott does not know how much time he has left.

Wounded Warrior Project thinks that no veteran should have to go through what Scott went through. This is why we believe that access to care for all veterans who suffered toxic exposures is an urgent priority, and we think that any veteran who has served in an area of known exposure should be eligible for permanent enrollment in Priority Group 6, regardless of the location or timeframe in which they served, now and in the future.

And while we see health care as an urgent need, we also recognize that benefits, including disability compensation and DIC eligibility, are critically important. That is why we support the establishment of a permanent framework that requires VA to respond to scientific data and create presumptive service connection whenever there is a positive association between an illness and an exposure, in a timely and transparent manner. Once again, we feel this should apply to all toxic exposures, regardless of era or location of service.

Finally, we believe there are several ways to improve the process for direct service connection, and these include concession of exposure to burn pits and other toxic substances for all current-era veterans who served in areas of known exposure.

Senators, the Wounded Warrior Project believes that we owe it to veterans like Scott to get this right, and we look forward to continuing to work with the Committee to address this urgent issue in the 117th Congress.

Chairman Tester, Ranking Member Moran, this concludes my Statement and I look forward to your questions.

Chairman TESTER. Thank you for your testimony, Aleks. We are going to start with questions. These will be 5-minute rounds. I

would ask the Senators to try to stay as close to that as you possibly can.

I will yield my time to Senator Hassan from New Hampshire, because she has a conflict at the top of the hour. Senator Hassan.

SENATOR MAGARET WOOD HASSAN

Senator HASSAN. Thank you so much, Mr. Chairman, and thank you for your courtesy in yielding the time. To Ranking Member Moran, thank you as well for holding this hearing. To all of the witnesses, thank you for your testimony today. To the veterans, thank you so much for your service and sacrifices, and I particularly want to thank Mr. Thompson and Mr. O'Malley for your testimony. It is not easy to talk about these things in front of an audience but it makes such a difference for your fellow veterans and your fellow Americans to hear what you have to say, so thank you.

I am going to, I think, just stick to one question, because I have to go preside at the top of the hour, which the Chairman referenced, and I want to talk to Mr. Liermann and Mr. Morosky, because as we examine these issue we have to recognize that unfortunately servicemembers, veterans, and their families may have been exposed to toxic environments not only while serving overseas but also while they are right here at home.

In my State of New Hampshire, members of the military who serve at the Pease Air Force Base, their families, and people living in the surrounding community, were exposed to drinking water contaminated by high levels of PFAS, pollutants that are known as, quote, "forever chemicals." I know that the Biden administration is currently considering implementing better PFAS safeguards, and I strongly support these efforts.

Unfortunately, toxic exposure at domestic sites is not unique to New Hampshire. For example, decades ago, Camp Lejeune in North Carolina experienced dangerous water contamination, and the VA has since appropriately created a presumption of service connection for certain diseases for veterans and their families who were exposed at Camp Lejeune.

So, Mr. Liermann and Mr. Morosky, can you speak to some of the issues facing veterans and their families who were exposed to toxic environments within the United States, and any lessons learned from Camp Lejeune that can be applied to other situations such as the PFAS one?

Mr. LIERMANN. Thank you, Senator. I believe if you take a look at the types of toxic exposures, just domestically, within the U.S., outside of Camp Lejeune and the PFAS there then is also Ft. McClellen, Alabama. So there is a history of toxic exposures throughout the country, even domestically. So finding a way to establish something, as you mentioned, like Camp Lejeune, is what we are all striving for, especially the PFAS issue. They are now indicating over 600 military installations have been known to have high levels of PFAS.

So there are several different things that can be done, like setting up a presumptive like Camp Lejeune, or like the idea of the concession of exposure as noted in S.437. If we could conceded their exposure to those chemicals now, instead of waiting for studies and

science, we can provide a quicker, direct path for service connection for diseases related thereto.

Senator HASSAN. Great. Thank you. Mr. Liermann?

Mr. MOROSKY. Senator, I will just add that in the past we have often dealt with toxic exposures on sort of a conflict-by-conflict basis. What we envision would be offering access to health care and benefits for all eras on the same basis, and toxic exposures now and in the future, and that would also include domestic as well as overseas. We think that those who were exposed on a domestic basis should be offered care and benefits on the same basis as those overseas.

Senator HASSAN. Thank you very much. I look forward to working with you all on that. To all the witnesses, thank you, and to those advocating and researching on these issues we are really grateful for your work too.

Thank you, Mr. Chair. I yield back.

Chairman TESTER. Senator Moran.

Senator MORAN. Chairman Tester, thank you.

Chairman TESTER. Sherrod, you have got to mute.

Senator MORAN. Thank you very much, Mr. Chairman. I was waiting to see if Senator Brown had any other comments before I began my remarks. Let me start with Mr. Morosky. Can you opine on what you believe to be Congress' role in adding additional presumptions to the list versus the Executive branch, the Department, and others exercising its authority? And can you comment on any concerns that the precedent being set, if it continues to be left to Congress to add to that presumptive list.

Mr. MOROSKY. Thank you, Senator Moran. You know, in the past we have seen presumptive service connections that are established by Congress, with bills in Congress, and we have seen cases where the VA acted based on scientific evidence. We believe it is ideal when the VA acts based on scientific evidence, which is why we support a framework that would require them to respond to the scientific data in a timely and transparent manner. We believe that veterans deserve that. While we will continue to support bills introduced in Congress that establish presumptive service connection by statute in that way, we also think that it should not always take an act of Congress for veterans to have their claims granted, and it should ideally be the VA that is responding to the scientific data and giving that.

Senator MORAN. I guess that is a good point, because often the expression is it will take an act of Congress, as if that is something nearly impossible, but we generally respond when something is not being done, less than we are able to do. So thank you for that analysis.

Mr. Liermann, in your testimony you noted the barriers to veterans' claims for benefits related to burn pit exposure. Noting the history of toxic exposures that have face multiple subsequent generations of veterans and future uncertain combat environments, what actions can Congress take to most immediately—most immediately—make an impact for veterans suffering from toxic exposure today? In other words, I think my question is, what can we do now that would make a difference now?

Mr. LIERMANN. Thank you, Senator. Two things. I believe, one, if we take this idea of the concession of exposure and implement it now—it does not require science, it does not require anything additional—it is a quicker path for direct service connection for veterans. Two, we need to establish a framework, as Aleks has mentioned and several other people mentioned, that has a lot of these built in so we are not spending time squabbling over the science each and every time there is a new presumptive or a new exposure. We have something in place so immediate action can be taken, so veterans do not have to continue to wait decades for access to health care and benefits.

Senator MORAN. Thank you for that answer. Let me turn again to Mr. Morosky and ask, any comments that you have about expedited health care for veterans for toxic exposure? I think your testimony indicates how important it is for a quick answer. Is there something specific that we should know why that is important, or is that just self-evident?

Mr. MOROSKY. We think it is self-evident, and we think it is an urgent need that is not being met for veterans like Scott, that I spoke about in my opening Statement, Mr. Ranking Member. Access to care is something that is provided to Vietnam veterans on a priority group 6 basis, without the need to establish a presumptive service connection. It is provided to post-9/11 combat veterans but only for a period of 5 years. Once that 5-year window runs out, veterans like Scott, who have serious illnesses seven or 8 years later, are turned away, unfortunately.

Senator MORAN. So it may be true, if I had time to ask the medical doctors that are our witnesses today, and maybe I will have that chance later, that there may be specific nature of these conditions that so much better result can occur if treatment begins quickly. I would guess that is true in most instances, but maybe there is something unique about these circumstances that our service men and women face.

I would conclude, Mr. Chairman, by saying that a number of years ago, certainly during my time in the Senate, a group of veterans met in Wichita, Kansas, and it was family members, and I would highlight what has stuck with me since then, probably for a decade now. And that is that these veterans and their family members were there because they were concerned about their own children and grandchildren. And the consequences that occur from these exposures, those consequences are appearing their children and grandchildren. It has always stayed with me that I know service men and women are willing to accept risks for their service, but I cannot imagine one of them thought they were doing anything that might harm a family member, or somebody who may not even be born yet.

And so we will continue. Senator Blumenthal and I have worked to try to make certain that we get the scientific and medical evidence necessary to determine what role the Department of Veterans Affairs, what we as Congress should do for another generation of service men and women's family members.

Mr. Chairman, thank you.

Chairman TESTER. Thank you, Senator Moran. Mr. Thompson, I am going to start with you. First of all, thank you for your testimony. Thank you for your service.

Your health problems started to manifest toward the end of your second deployment in Iraq in 2009. Could you tell me, how long from when you started to experience symptoms did it take before a doctor concluded that burn pits played a role?

Mr. THOMPSON. Yes, sir. It was September 2009 is when I started feeling the effects, and I would say it was the summer of 2010 that the doctor from Walter Reed had listed that the burn pits and environmental agents caused the effect.

Chairman TESTER. I appreciate that. Has either the DoD or the VA conceded that your health conditions were caused directly by your exposures in Iraq?

Mr. THOMPSON. No, sir. Not to my knowledge.

Chairman TESTER. And what has that meant for you on a day-by-day basis? What has that meant?

Mr. THOMPSON. Well, I was denied my Army retirement because if it was not a combat action then I do not receive that retirement.

I am sorry for being slow. I am going on 3 days without any sleep.

Chairman TESTER. Well, you are doing just fine. Do not apologize for that. We appreciate your testimony.

Dr. Szema, you have done some pretty amazing research on lung injury in Iraq and Afghanistan veterans. I want you to walk us through some of the conditions that your research has found to be associated with burn pit exposures.

Dr. SZEMA. So the most common ones would be asthma, bronchitis, and COPD, chronic obstructive pulmonary disease, even in the absence of smoking. But we see a rare form of lung disease called constrictive bronchiolitis, which have been duplicated by Dr. Robert Miller of Vanderbilt. And the most severe patients are like Will, who have had lung scarring with the constrictive bronchiolitis, and actually Will was gracious enough to give his native lungs to us. We actually determined that there were burned particles in his lungs. They were polycyclic aromatic hydrocarbons, which are products of incomplete combustion. So he has got burn pit stuff in his lungs.

And we can duplicate it. He was at Camp Victory. We, at the surface, grabbed samples from Camp Victory, Iraq, taken in that timeframe, and we found those same particles as well, burn particles in the actual dust, that the U.S. Geological Survey connected for us.

Chairman TESTER. I appreciate that. Mr. O'Malley, by the way, you have the same name as my elementary principal so I feel like I am talking to him. But I want to thank you for your service. I want to thank you for your testimony. You talked about not having health insurance until you learned you were eligible for VA health care, from a fellow Vietnam veteran. Can you tell us about your experience with VA health care?

Mr. O'Malley. Thank you, Chairman. For those of you not familiar with Houston area, I get my primary care and my special care at the Michael DeBakey Veterans Affairs Medical Center in Houston. It is located in basically the heart of the Texas Medical Center,

which is one of the finest research areas for medicine in the United States and in the world. Many of the doctors who do specialty care for me when I need it are wearing also Baylor College of Medicine tags and are receiving their training under the supervision of Baylor and the VA.

I have had, in my 11 or so years of treatment at the VA, exemplary care, and it is by far the longest relationship with a primary care physician I have had in my life. I recently, for the first time, experienced a new primary care physician after mine retired. The hearing aids I am wearing, the treatments I have received for conditions that have arisen have been top notch. And in my experience talking to other veterans that I know, they may be frustrated with bureaucratic things with the VA, but I do not know anybody in the Houston area that is upset with their medical care.

Chairman TESTER. That is good news and that is news we always like to hear on this Committee.

Senator Tillis, you are up.

SENATOR THOM TILLIS

Senator TILLIS. Thank you, Mr. Chairman, and thank you to the witnesses for testifying. Mr. Chairman, I want to thank you, in the time that we have worked together, since I have been on this Committee and particularly with your vocal support for trying to move forward with the TEAM Act. I want to thank former Chair and Ranking Member Moran for having a vote where the TEAM Act was passed unanimously out of the Committee.

I know that one of the witnesses referred to the process that they go through with the VA, when dealing with exposures and presumptions as—Shane, I think it was you, actually, that said it was complex and uncaring, exposure and presumptive process. I think it is. And that is why I think the TEAM Act, and actually the Burn Pit Exposure Act that was co-sponsored by Senators Sullivan and Manchin, are so important for us to get before this Committee.

We have a coalition of some 30 veteran service organizations. I think every one that is not even on the coalition supports the bill. And I believe that it moves forward with getting rid of some of that frustration and not putting the weight on veteran, but having an independent review, and maybe let the tie go to the veteran. And I look forward to working with you and the other members to get that to the floor and ultimately to the President's desk.

I am sorry for not being here earlier. We have got another committee that I have to speak at shortly. But the other thing that I hope we start thinking, I think we are going to make progress on the TEAM Act. I think that we can figure out a way to resolve some minor differences with some of our colleagues on the House side and move forward with the bill in this Congress, and hopefully the first half of this Congress.

But also, as I was looking at some of the provisions in the TEAM Act, something as simple as an exposure questionnaire when a veteran comes into a VA facility, I think we have got to start looking further upstream. And I think I have made note for my staff that I would like to have that exposure questionnaire as a part of a TAP program, before they ever transition into veteran status.

And I would even like to go further. I would like to be able to provide information in the electronic health record for a servicemember to where we are capturing information that we can predict—it may have been an event that they can no longer remember, but with increased situational awareness on the ground there should be some way to be able to capture that information over the life of a servicemember so that we could even predict someone who may fill out that form and just blow through it because, you know, when you go through TAP what you are really wanting to do is make the transition.

I want to get to a TAP program of one. I want to know everything that we need to know about that servicemember, up to and including potential health risk exposures, so that we can actually vector them immediately, before they ever have any sign or a symptom, and then have the weight of their service history, the medical and exposure dimensions of their service history, as being the weight that they carry to that process, along with a fairer process with respect to outside consultation on exposures.

So, Mr. Chairman, this is a group of people that my office has spent a lot of time with, and we are going to spend a lot more time because we are going to do everything we can to get the TEAM Act and some great ideas from other members embodied in the same bill, and we are going to need your support to make sure that in this Congress we can all have a celebration, hopefully without masks and not virtually, of what I think is a major step forward. We have made great progress.

I got exposed to this when I first came to the Senate 6 years ago, with the Camp Lejeune situation. We fought and I dealt with administrations, Democrat and Republican administrations, where the presumptions were almost maddening, and, you know, as a U.S. Senator I found it maddening. I cannot imagine what it would be like for a veteran who has encountered an illness, that is going through this process.

So, Mr. Chairman, I am not going to ask any other questions except to say, in my remaining minute, I really do hope that you all will not only think about those veterans but think about that servicemember, that active servicemember, and what more we can do to better integrate and better identify these problems before that servicemember or that veteran may ever know that they have an exposure or a problem.

Chairman TESTER. Thank you, Senator Tillis, and it is fair to say that you and your predecessor, Senator Burr, on this Committee have been on this issue for a long, long time now, so we appreciate your leadership.

Next we have Senator Brown.

SENATOR SHERROD BROWN

Senator BROWN. Thank you, Mr. Chairman, and I apologize for my talking when I was not muted before. I was just asking if Mr. Hamilton was actually here, because I could not see on the screen, so thank you. I know he is remote, so thank you. And I appreciate the comments of Senator Tillis a moment ago.

Thanks for the hearing, first. Thanks for the witnesses' testimonies. I really am heartened the way that all of your talking

about toxic exposures. I appreciate Senator Tester's leadership on Agent Orange. We have still got to work on hypertension, but the success of last year of presumptive eligibility were really important to so many veterans who I have met in Ohio and I know across the country.

I want to talk about burn pits a little bit. I appreciate comments earlier. Mr. Hamilton, I will start with you—Mr. Thompson, I am sorry. Mr. Thompson, let me start with you. Thanks for your testimony today. I heard part of it and then I heard your answer to a couple other questions. I am sorry, I was on another meeting. Nobody should have to go through what you have gone through, still, what your family has been through.

Mr. Thompson, what should servicemembers who are currently overseas and exposed to burn pits do? What steps do you think the Army and DoD should take? So answer that, and then what steps the Army and DoD should take to prevent this exposure in the first place, to burn pits.

Mr. THOMPSON. Well, first and foremost, they have already improved incinerators back when—I think back when I was still in country. And the only thing they need to do is just implement it and get them up, get them running.

And then, it comes back to my memory. When I was there, there were some of the foreign workers that we had at Camp Stryker, every day I saw them wearing masks, and now I wish I had took their lead and wore one every day. I do not know if it would have helped but at least it would have been something.

Senator BROWN. Yes, Okay. Thank you, Mr. Thompson, and thanks again for serving, and I hope you are seeking out results and getting better support from others and from the VA, especially.

Dr. Szema, Dr. Miller was before our Committee a year, 18 months ago maybe, and I will ask similar questions to what I asked him. You have treated servicemembers exposed to burn pits. You have treated other environmental exposures. Do DoD and VA have the protocols in place to correctly diagnose these respiratory illnesses, and I think you mentioned constrictive bronchiolitis? Are we doing that right? Do we have the protocols in place?

Dr. SZEMA. The problem with diagnosing constrictive bronchiolitis is that it is going to require a lung biopsy. Now what we are working on at my hospitals, Norwell Health, with my colleague, Dr. Agarwal, is transbronchial cryobiopsy. So that is a way of getting a piece of lung without taking patients to the operating room. So that is in the formative stages, but we have a robust interventional pulmonary program. So that will be a game-changer in terms of diagnosing without going for a surgical biopsy, which was one of the criticisms in the past of taking everybody to the operating room.

The other problem is there is noninvasive testing that I use that is not widely available in the VA, and among the things we do are something called impulse oscillometry, and it is a $15,000 machine, and it takes 2 minutes. You put your mouth on it and it determines if your distal areas are narrowed. And if you do not reverse with an inhaler, it suggests that your distal airways are narrowed and fixed, consistent with constrictive bronchiolitis, in the absence of

other disease. So some of the tools are not available widely in the VA.

Senator BROWN. Thank you. My last question, Mr. Chairman, Senator Portman and I have introduced a bill named after Heath Robinson, an Ohioan who served in Iraq who was exposed to burn pits and later died, far too young, of cancer. I hope that our bill will help connect the dots between veterans' health outcomes and burn pit exposure so that veterans get the benefits that they have surely earned.

This is for Mr. Liermann, or maybe anybody else. Do you happen to know at what rate burn pit victims' disability claims are approved?

Mr. LIERMANN. Thank you, Senator. I believe the report the VA put out last year was roughly 78 percent of the claims are being denied when they are specific to burn pits, so roughly 22 to 24 percent are being granted, or 30 percent. I am a Marine; math is not my strong suit.

Senator BROWN. Why do you think, representing veterans, why do you think that is the case, that that many are denied?

Mr. LIERMANN. Well, I think part of the problem is VA is not recognizing that exposure as being toxic exposures, plus there are no presumptive diseases. Fifty percent, or over 50 percent of those cases being denied are because they do not have a medical link or a nexus between that exposure and that disease, and that is why S. 437 would definitely remove some of those barriers and make it easier to get direct service connection in those cases.

Senator BROWN. Mr. Chairman, if I could do one more real quick question. Mr. Liermann, do you see a time when we have presumptive eligibility for burn pits like we did, many years too late, for Agent Orange?

Mr. LIERMANN. I would love to see that. Yes, absolutely, and I hope we get to that point. The problem is, it has already been, since the first Persian Gulf we are talking 30 years since burn pits were again active, since 2001. We are way behind the curve here. So I hope we do get to that point. I just hope we find a way, in the intermediate, to establish a way to get them health care, as Aleks was referring to, and service-connected benefits now, so they do not keep suffering and waiting another 10, 20, or 30 years.

Senator BROWN. Thank you. Thank you, Mr. Chairman.

Chairman TESTER. Yes, make no mistake about it, Senator Brown. We hold these hearings for two reasons: to gather information for the Committee members and to help educate the VA that they might take action before Congress does.

Senator Blackburn, you are up.

SENATOR MARSHA BLACKBURN

Senator BLACKBURN. Thank you, Mr. Chairman, and thank you to each of you for being with us today.

Just a couple of quick questions. I have done a good bit of work on the K2 veterans issue. We have folks in Tennessee that were part of the 5th Special Forces Group, the 160th SOAR, and, of course, they spent time there at K2. And we have worked diligently. The NDAA has a study, a 180-day study, that we are going

to look at some of these veterans and getting to them what they need.

It is of concern to us that we have the number of denied veterans that we have, and the hope there is that the TEAM Act would help with removing some of those barriers, by getting the K2 veterans included in the Burn Pit Registry, getting that exposure there. That is something that we think is going to be vital.

Dr. Szema, I do have a question I wanted to ask you, because we have got the MISSION Act that allows veterans to go now outside of the VA system and seek care when they need it. So what I would like to hear from you is what ways could DoD proactively, or the VA proactively, pursue measures that would adequately capture a servicemember's long-term respiratory health, and then for issues like those that are suffered by our K2 veterans, seek that care there in their communities?

Dr. SZEMA. So as I mentioned earlier, we are advocating for centers of excellence, sponsored by the NIH or NIOSH, analogous to the World Trade Center Monitoring Programs, because in order to capture the veterans, you really need a center of excellence that is impartial and academically based, and has the resources and the specialized diagnostic testing available that is largely not available at community veteran hospitals.

Senator BLACKBURN. And I would add to that, timely, because that is part of the problem. They do not have that timely access.

Dr. SZEMA. Right. I agree. And for example, I am in New York State. As part of Northwell Health, you know, we are the largest employer in New York State and we have 22 hospitals. So we were able to respond to the COVID pandemic very rapidly in New York, and it is one of those things where, you know, resources and expertise do matter. And I think, yes, you have to share with the VA, but you also have to rely on where the expertise is.

For example, 4DMedical is a company that just got FDA approval last year to do a noninvasive test and use software to stack all the CT scans and fluoroscopy to do a 3D image and make a movie and tell me where the ventilation is abnormal, and it is color coded. So that is brand new. You have to be able to respond and be agile, and I think the problem with bureaucracy is, you know, these soldiers are not getting the care because of the existing framework of the benefit system.

Senator BLACKBURN. Thank you. I appreciate that. Mr. Chairman, I yield back.

Chairman TESTER. Thank you, Senator Blackburn. Senator Manchin.

[No response.]

Chairman TESTER. Senator Manchin? Senator Tuberville.

SENATOR TOMMY TUBERVILLE

Senator TUBERVILLE. Thank you, Mr. Chairman. Thank you for testifying today. This is kind of alarming, a little bit. You know, I grew up in Vietnam era. I lost a lot of my buddies, older buddies, to Agent Orange. It seems like it takes us forever, you know, to come up with any kind of answer to something like this, and now we have the burn pits. And, you know, sooner or later the type of country we have, you would think we would come up with some

kind of idea of what affects people. We knew smoke affects people, and we have all these burn pits.

But, Chairman Tester, I want to thank you. One of your top priorities is adding hypertension to, you know, this list, Agent Orange. My dad was in the military. He landed at Normandy at age 18, and fought all the way across Europe, and 30 years later died of a heart attack, of hypertension. And it is there. It is proven. Stress is a huge part of it, and you cannot imagine the stress that you have going through some kind of battle or war in the theater, especially in the type of areas that we fight in. You know, now we are in the mountains and the hills and deserts, a few years before that, and then the jungles back in my era. It is just amazing. But we have got to come up with advances in equipment.

That is one thing I want to ask the doctors is, you know, once we go into an area, is there any way that we—preventive medicine is the best, you know, for all of us. I mean, if you go get a physical you tend to be able to find out things a lot quicker than just sitting around. And we could do the same thing when we are going to go to the theater, and we are going to fight these wars. We ought to be able to understand what we are getting into.

And I want to ask the doctors about, you know, equipment and preventive measures. You know, for instance, this toxic exposure in the theater, do we have anything now that we give our troops that are out in the field, that are around—even if we have got these containers that we are burning it in, you are still going to have some exposure. Any doctor.

Chairman TESTER. Either Dr. Szema or Dr. Kelsey, you get that question.

Senator TUBERVILLE. Yes.

Dr. KELSEY. Senator, I am not military personnel but my expertise is really in the area of the effects of exposures. I would say that I agree with you, prevention is the primary way to go here, and I would echo what Senator Tillis said, in the sense that we have got trouble trying to figure out what is exposure related if you do not measure it. And I think his comment was really quite insightful in the sense that I think the military does not do a great job of assessing exposure, and certainly they do not keep track of it.

So in terms of going forward, one of the best things in the prevention world, that I can think of, is to act on Senator Tillis' observation that they can do a better job assessing and storing information on what active service encounters in terms of exposures.

Senator TUBERVILLE. Exactly. Thank you. You know, we send these young men and women to war. We pay them $38,000, and I get more calls on veterans than anything, and I have been doing this for 2 months. And it is amazing that they cannot get an appointment, they cannot get in. I know I have got something wrong with me because of the toxic I have got in my lungs. They tell me I have got to have more proof. We have got to do a better job of taking care of our young people. If we are going to go to war, we have got to understand, we have got to pay the price for it, on both ends.

And so I want to thank you guys for your help, the Wounded Warriors and Disabled Veterans. It is so important, because what

have we been fighting now, 20 years? Twenty years in these two wars we have been fighting, and we have got a lot of young people coming back, they have got bad problems, and PTSD—I am waiting every day. I will get a call from my best friend, wondering whether his wife is going to tell me whether he has committed suicide, because he cannot sleep. And he gets very little help at the VA, because it takes him a while to get in there.

So thank you for your help. I know we have got huge problems. We look forward to working with you and I look forward to working hard on this Committee. Thanks for your help, and Doctors, thank you for your help, and you veterans, thanks for your service. Thanks for everything that you have done for our country, and hopefully we can do a lot better job taking care of you.

Thank you, Mr. Chairman.

Chairman TESTER. I understand that Senator Manchin is on the phone? Speak to me, Senator Manchin.

SENATOR JOE MANCHIN

Senator MANCHIN. I am on video for you, Mr. Chairman, just for you. I found a video that worked, and I came to make sure I could see you in person.

Thank you, Mr. Chairman. I appreciate it very much. Mr. Thompson, I wanted to take a moment to thank you for your over 23 years of service in the United States Army and the West Virginia National Guard. I am honored to have the opportunity to meet you, and I am proud to be a West Virginia because of veterans like you who have made unimaginable sacrifices for our country.

Your testimony sheds light on so many problems veterans are facing when it comes to toxic exposure. But one in particular grabbed my attention. You wrote that you do not qualify to receive your retirement until age 60 because your injuries were not combat related. To me, this is just one part of a larger issue when it comes to toxic exposure. We are not providing parity between active-duty and reserve component service.

So my question would be, what can Congress and VA do to ensure that veteran families are taken care of and receiving the benefits they are entitled to after our veterans are gone? Mr. Thompson?

Mr. THOMPSON. Yes, sir. I want to say just make sure that the benefits that are there are the same across the board, because the way I felt after I was told that is that it is cheaper to send a National Guard soldier over to get injured or killed than it is an active duty soldier.

Senator MANCHIN. Oh, my God. That is hard to believe.

Mr. THOMPSON. That is exactly how I felt. I am not asking for, you know, anything special. None of us are. It is just, you know, if we do this, when I put on that uniform I gave 150 percent. And when I take off that uniform I expect 150 percent.

Senator MANCHIN. Right. Mr. Thompson, let me just tell you this. There is not a member on the Veterans Committee, Democrat and Republican, and sure not our Chairman or our Ranking Member, that does not believe that the fairness should be across the board, and we have all the respect, because all of us have National

Guards that we basically love and support. So you making this testimony, hopefully it will make the changes that need to be made.

My followup question to you would be, I would like to say to you, and all West Virginians who are servicemembers or veterans, that I am going to keep fighting for your access to health care and benefits in both my role on the Senate Veterans' Affairs Committee and the Armed Services Committee. So I just thank you for your service. I will say that I am proud to represent one of the most patriotic States in the Nation. As you know, we have a lot of veterans, on a per capita basis, one of the highest in the country.

So, Mr. Thompson, thank you so much, sir. I just cannot thank you enough, and your testimony, I think, is going to make a big difference in what we are going to do and how we can make the changes. Thank you, sir.

Mr. THOMPSON. Thank you very much.

Senator MANCHIN. You are welcome, sir.

I would like to address this to Mr. Shane Liermann. Mr. Liermann, first I want to thank you personally for all you have done and been doing to help us with the Veterans Burn Pits Exposure Recognition Act. I know you have been working tirelessly behind the scenes with my staff and Senator Sullivan's. I know you agree that we need to pass this legislation as soon as possible to ensure our veterans have the access to care that they desperately need.

So my question would be, can you outline some of the consequences in the short and long term if we do not pass this bill and VA does not concede veterans' exposure to the specific toxins of burn pits?

Mr. LIERMANN. Thank you, Senator. Unfortunately, if we do not pass this we are going to continue on the path we have been on for 20 years, and that means numerous veterans exposed to burn pits will continue to suffer from those illnesses, they will still continue to be denied health care, and we will not get any closer to establishing presumptive diseases.

So if we do not do anything right now, while we wait for presumptives or find other science that we need to establish, millions of veterans exposed to burn pits will continue to suffer, without VA health care, without the peace of mind for benefits for their families, when they pass, due to those diseases.

Senator MANCHIN. Let me just thank you, and, Mr. Chairman, let me just finish up by saying to you and Ranking Member Moran, that part of the reason I have enjoyed working in the Senate Veterans' Affairs Committee is because regardless of our party we always find a way to come together to support our veterans, in the most bipartisan way.

I am proud that has been the case with the Veterans Burn Pits Exposure Recognition Act that Senator Sullivan and I re-introduced. We have 18 co-sponsors and almost half of the Committee signed on. However, of those 18, only 6 are Democrats. We must do better. I am calling on my Democratic colleagues on the Committee to make joining the important piece of legislation a priority. And I know you can lead the charge, Mr. Chairman, as you always do for the right cause. Thank you.

Chairman TESTER. Thank you, Senator Manchin. Senator Sinema, I understand you are on.

SENATOR KYRSTEN SINEMA

Senator SINEMA. That is right. Thank you so much, Mr. Chairman. I appreciate it. I want to start by thanking everyone for appearing today, and thank you for sharing your personal experiences and helping the Committee consider this important topic.

As some of you have already alluded to, toxic exposure is an issue that requires this committee to take a retrospective and prospective view. We need to look back on our military operations and make amends where our veterans have been harmed by toxic exposures. And we also need to look at the current practices, the way the military uses these chemicals in burn pots and then do better to protect future generations of veterans from the terrible health impacts of these toxic exposures.

In Arizona, we were recently notified of PFAS contamination outside of Luke Air Force Base. Mr. Liermann, you highlighted that DoD found evidence of over 600 installations with contaminated ground or drinking water. The Department of Defense has established a task force to address PFAS contamination. Do you feel that is enough, and what other steps need to be taken to ensure a national strategy to address PFAS use and the health risks associated with that use?

Mr. LIERMANN. Thank you, Senator. I do not think it is enough. I think what we need to do is we need to start looking at are these exposures causing long-term diseases within those exposed to that PFAS-contaminated water. That is one. Two, we need to get established a presumptive process to make sure the men and women exposed have that access.

So we need to be doing more, quicker, and I think that is the thing we are all talking about, is we are not moving fast enough in reference to how quickly we are learning of how severe some of these exposures really are.

Senator SINEMA. Thank you. My next question is for Mr. Morosky. You highlighted in your written testimony that the Wounded Warrior Project has been using DoD Individual Longitudinal Exposure Record, ILER, to help identify a link between a person's service and their exposures. I have repeatedly asked DoD and VA officials why is it that servicemembers or veterans are left to prove that they were exposed to toxic substances during their service, and DoD has answered that the ISER will enable DoD and VA to proactively identify exposures, taking the burden off of the servicemember or veteran.

Is the ILER being used by the VA and DoD to proactively identify exposures?

Mr. MOROSKY. Senator, we do not find that VA is using the ILER consistently. It is a relatively new tool. Our service officers request ILER reports and submit them as evidence for veterans' claims, and we have seen some success with that. However, we think that there should be better standards for when VBA claims personnel look into the ILER themselves in order to better develop the claim and help the veteran establish concession of exposure.

Senator SINEMA. So do you think the ILER could be developed to the point where it could be useful to help proactively address these claims and remove the burden from the veteran or servicemember, him or herself?

Mr. MOROSKY. We think it is effective now. It will never be 100 percent effective because there are gaps in it, and the further back it goes, the more gaps that there are. So we think that the improvement that really needs to be made is for VA claims personnel to be instructed how to use it, for there to be standards on that, but also for them to understand that a lack of evidence in ILER should never be grounds alone for a denial of claim.

Senator SINEMA. That is an important point. So ILER could be used to supplement or help prove, but the lack of information in ILER should not be used as dispositive to say that there is no injury or no exposure. Thank you. I appreciate that.

My next question is for Drs. Szema and Kelsey. I hear from researchers and those gathering data on toxic exposure that though the VA and DoD are collecting information on toxic exposure through the various environmental health registries, this information is not available to researchers outside of DoD and the VA. If that is true, what would the advantages be to opening up the data to researchers outside DoD and VA if done in a way that protects the privacy rights of individuals?

Dr. SZEMA. I think it is important to open up the data, but it depends on what is in the data base, otherwise it is garbage in, garbage out. For example, you know, one of my premed students is now graduating from medical school, Guadalupe Jimenez. When she was in the Marines she burned her trash on the side of the road in Iraq. She did not dig a pit. So in the questionnaire for the open-air burn pits registry she was not exposed to a burn pit, even though she definitely did it for a year.

If you shoot a gun and you are lying on your stomach you are going to be exposed to the dust in the sandstorms that are there, and we know that the dust and the particulate matter in the sandstorms are frequent, they can rise as high as a mile or two up in the air, and they contain particles that include burning trash.

So the questionnaire is key, and, you know, locations of military bases are often top secret. They are not on the map. So often the soldiers would say, "I served here, here, and here," but that is not indicated in their record, as well. So I think there are some gaps that are going to be there, just on the basis of the current questionnaire.

Chairman TESTER. Thank you, Senator Sinema.

Senator SINEMA. Thank you.

Chairman TESTER. Senator Blumenthal.

SENATOR RICHARD BLUMENTHAL

Senator BLUMENTHAL. Thanks, Mr. Chairman. Thank you so much for holding this hearing, which is so vitally important to all of our veterans, and to all of the witnesses for being here today. And I want to thank Mr. O'Malley and Mr. Thompson, particularly, for sharing your stories.

I was proud to support efforts led by Chairman Tester to grant a presumption of service connected for Parkinson's disease, bladder

cancer, hypertension, and hyperthyroidism for veterans exposed to certain herbicide agents while serving in Vietnam, and I was proud, as well, to see the presumption for three of those conditions included in the recent National Defense Authorization Act, and we are going to continue to fight to have hypertension included on this presumption list as well.

I am really concerned that we are repeating our past mistakes with more recently discovered toxic exposures like the ones associated with the burn pits at Karshi-Khanabad, also known as K2, the air base there. We must ensure that justice for these veterans is achieved now, and no longer delayed, the way it was for Blue Water Navy veterans exposed to Agent Orange.

I appreciate your organizations, Mr. Liermann and Mr. Morosky, supporting my K2 Veterans Care Act. I understand that the DAV and the WWP assist veterans in pursuing veterans' benefits claims, and I am grateful for all of your work, and I am hopeful that Congress will act urgently to make it easier for veterans to receive the benefits they need and deserve.

As Mr. Liermann noted in his testimony on a related topic, it has been decades since Congress or the VA has recognized additional radiation risk activities. Without this recognition, veterans face insurmountable barriers in having their radiation diseases recognized, and therefore in receiving the care and benefits they need. I want to thank the Yale Veterans Clinic for pursuing claims relating to the Palomares disaster.

I have introduced, and I have led the Palomares Veterans Act in prior sessions of Congress, and I will introduce it again in the 117th Congress. The Palomares nuclear accident caused untold suffering and pain to men and women in uniform sent to the cleanup without proper protection and guidance, and the VA's unwillingness to review shoddy data from the Department of Defense has led to unconscionable delays for these veterans. They are aging. They cannot wait any longer.

I have been encouraged by what Secretary McDonough has told me about his pursuing greater disclosure in the future from the Department of Defense in incidents like this one. The Department of Defense has a critical role to play in these toxic exposure incidents, both in providing information that makes it possible for veterans to pursue their claims, and with the VA in mitigating toxic exposures in the first place. They can prevent a lot of these harms. They need to take action. The DoD has a moral imperative as well as a military one.

So my question is to Mr. Liermann. Could you outline for the Committee the unique barriers facing radiation-exposed veterans, including the veterans at Palomares?

Mr. LIERMANN. Yes. Thank you, Senator. When we start talking about presumptive diseases related to ionized radiation exposure, there are several conditions that have to be met. One of those is veterans must have participated in a recognized radiation risk activity in order for them to be considered presumptive to assign one of the diseases. Once they determine it is a radiation risk activity, then they send it out to guesstimate on the amount of radiation they were exposed to, or the rems, to determine if that was enough. Then they send it to a medical specialist expert within VA who

then will make a determination if that amount of radiation they were exposed to could have caused their disease.

The problem is this does not sound like a presumptive process. Making them jump through every one of these hoops no longer sounds presumptive. It sounds like a direct service connected requiring all these things. But without that radiation risk designation, they cannot be considered a part of the presumptive radiation disease process.

Senator BLUMENTHAL. Excellent answer, and unfortunately my time has expired. I have more questions, and I may send them to you in writing. This panel is an excellent one, and again, my thanks, Mr. Chairman.

Chairman TESTER. Thank you. Thanks to all the folks who asked questions today, and I want to especially thank the witnesses who, quite frankly, did a marvelous job adding some meat to the bone on this issue.

We have a lot more work to do. I think this Committee is committed to doing it, and we are going to need all your help to get it done. But the bottom line is this is a big issue, and it costs a lot of money, but the fact is that taking care of our veterans is a cost of war. We should not send them if we are not willing to take care of them when they get back.

Thank you all, and we will continue the conversation. This hearing is adjourned.

[Whereupon, at 11:46 a.m., the Committee was adjourned.]

APPENDIX

Material Submitted for the Hearing Record

DONALD AND BARBARA
ZUCKER SCHOOL *of* MEDICINE
AT HOFSTRA/NORTHWELL

The 2003 invasion of Iraq, and resulting conflicts in the Middle East, have led to the longest, prolonged military deployment in U.S. history. One million troops have served in Iraq and Afghanistan during the eighteen-year conflict. Now, 26% of 150,000 military personnel in the VA Burn Pits Registry self-report new onset respiratory symptoms. We noted 14.5% of New York-based soldiers developed new onset asthma post deployment.

Airborne hazards may account for new onset lung diseases. Soldiers inhale dust storms, pollen, mold, and improvised explosive devices leading to shock waves in the lung and metal deposition. Blast overpressure from shock waves induces traumatic brain injury and post-traumatic stress disorder, PTSD, which, by itself is linked to asthma. Most importantly, these troops are exposed to burning trash in open air "burn pits." Uniformly, trash was lit on fire with jet fuel, JP-8, which contains benzene, a carcinogen. Burn pits burn at low heat generating more particles than incinerators. More particles are associated with increased all-cause mortality, cardiovascular diseases such as heart attacks and strokes, and lung diseases like asthma and COPD.

Military personnel often do not have pre-deployment lung testing other than a 2-mile run time. If a soldier returns with a cardiopulmonary exercise test that is 80% predicted post deployment, which would be considered within normal limits, if in fact pre-deployment she or he was 120%, then this is a significant decrease.

We propose NIH or NIOSH funded monitoring centers for affected patients analogous to World Trade Center Monitoring Programs, since in the greater NY area, for instance, most veterans are not seen in the VA, since they exceed income limits, are young with civilian jobs, and have commercial health insurance. We envision centers studying basic animal models, investigating therapeutic agents, clinically monitoring patients and conducting clinical trials.

The consultative National VA War Related Illness and Injury centers are few and neither monitor patients nor perform biopsies. We conceptually agree with 2020 bipartisan bill HR 8261 in the House and S. 4572 in the Senate which proposed to grant presumption of medical claims for all troops who were deployed to Iraq and Afghanistan since 2003. We agree with the concept that President Biden should propose for consideration in his first 100 days, presumption of care for war fighters with subsets of lung diseases post-deployment.

Even in 2020, 77% of veterans requesting compensation and pension medical exams for maladies beginning in Iraq and Afghanistan were denied medical benefits. The American Thoracic Society 2019 workshop argued for more research. The National Academy of Medicine encouraged continued research through a consensus platform for biomarkers and pre-deployment pulmonary diagnostic monitoring.

Not only should we honor the dead who have made the ultimate sacrifice in war, but we also should provide for the living: brave women and men who sacrificed their health for freedom.

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Statement of William Thompson, SSG, U.S. Army (Ret.),
For the Senate Committee on Veterans Affairs

March 10, 2021

My name is retired SSG William Thompson. I served 23 years, 3 months and 11 days in the United States Army and WVARNG. I have deployed twice with the WVARNG to Iraq. During my last deployment, I was stationed at Camp Stryker at the Victory complex. My symptoms of frequent coughing started around September of 2009 while in Iraq, in which my doctors and PA's treated me for what they thought were allergies. I returned to Fort Stewart, GA and after I mentioned to the doctors, I was having frequent cough, they did a CXR that revealed bilateral pneumonia. They treated me with antibiotics and sent me home to WV to follow up with my PCP in one week. After a week, I followed up with my PCP Dr. Remines, and he discovered after more testing that I had pulmonary fibrosis with nodules and stated that my lungs looked like an "80-year-old coal miners' lungs". He referred me to Walter Reed Army medical center pulmonary department where I was treated by Dr. Jacob Collins for 6 months. He admitted me to the Warrior Transition unit at Walter Reed and after 6 months of testing which included an open lung biopsy, I was informed that I had titanium, magnesium and iron in addition to silica in my lungs. They diagnosed me with Hypersensitivity Pneumonitis and Pulmonary Fibrosis. I gained 60 lbs. from the high amounts of steroids I was on daily. Because my lung disease was chronic, I was referred to Inova Fairfax Hospital by Walter Reed and was told I would most likely need a lung transplant in the future. I have been seen by Inova Fairfax Hospital Lung Transplant Clinic from February 2011 to the present time. During

that time, I have been on oxygen as high as 10 liters continuously. On June 6, 2012, I received a double lung transplant, after 2 months of follow ups, I was able to return home to start pulmonary rehab. The first year was a good year. I took all precautions and followed all the orders that were instructed by my doctors. Despite this, over the next 3 years, I went through periods of lung rejection and infections and decreased oxygen levels. I was back on oxygen again. On March 9, 2016, I underwent another double lung transplant. Lung transplants unfortunately are more susceptible to complications than other organ transplants since the lungs are exposed to everything from the environment.

My life and my family's life have changed since I returned home in 2010. I have to wear a mask in highly populated areas. I know wearing a mask is typical these days, but I have been wearing one since 2012.

It's hard to hang out with my kids only to tell them "I can't do that".

"Dad, let's go skiing" …sorry kids, I can't' do that

"Dad let's go swimming" …. sorry kids, I can't do that

"Dad, can you give me a piggyback ride?" Sorry Ava, I can't do that

"Dad, let's go fishing" Sorry Ethan, I can't do that because of the bacteria on fish

"Dad let's go to the beach" Sorry kids, I can't do that because of the bacteria in the water and the sun with my transplant medications makes me more prone to skin cancers.

Speaking of skin cancers, I am currently battling Trigeminal Neuralgia after having a skin cancer removed from my left cheek that aggravated my trigeminal nerve. This is a very painful, debilitating condition that is also known as the "suicide disease" and is known to be one of the most painful disorders known to medicine. It causes sudden, shock -like pain in my face that lasts from minutes to

hours at a time. Because of this disorder, I have added numerous medications to my previously very large daily pill regimen.

I don't feel like a man because my wife has had to take that role from me. There are so many things that I can no longer do.

I am a warrior of the United States of America. I gave my lungs for my country. The toxins in the air from burn pits and the dust in Iraq has changed my life. I am glad to be alive and home when so many did not make it home. My illness and injuries are different. I have heard so many times from the VA "we don't know how to treat you", or "you don't qualify or fit into our parameters for benefits". I have been denied TSGLI because the army does not think having a lung transplant is a "traumatic event". Luckily, we found the group, Semper Fi fund/America's fund who works with veterans and provided the funds to make my bathroom ADA accessible. Since then, the VA has helped me with one housing HISA grant, but only after being denied several times. My injuries are illnesses are different from other more common injuries from Iraq and because of that it took the VA 3 years to provide me with an air purifier in my home to keep my home free of allergens and dust. They also denied help in removing carpet in my home that was instructed by my doctors, so we had to pay for this ourselves. We have also taken out a loan to build a workout area in my home where I can work out and continue my pulmonary rehab during times of my illness or times when cold or flu season is at its peak. Although, I was 100% service connected through the Army and VA, I don't qualify to receive my retirement until age 60 because my injuries were not "combat related". I may not live to be age 60- I turn 50 this year.

Every day for me is a battle I continue to fight. I still have to battle infections and try to keep my body healthy from lung rejection. I still have to fight secondary problems related to my transplant. Hopefully, after hearing my story, it will bring awareness for not only me but others who are battling the same or similar injuries related to burn pit exposures from Iraq or Afghanistan. Thank you allowing me to share my story.

THE NATIONAL ACADEMIES REPORT
Veterans and Agent Orange: Update 11

Statement of Dr. Karl Kelsey
Professor of Epidemiology, Professor of Pathology and Laboratory Medicine
Brown University.

before the
Committee on Veterans' Affairs
U.S. Senate

March 10, 2021

Chairman Tester, Ranking Member Moran, and members of the Committee, thank you for the opportunity to testify today. My name is Dr. Karl Kelsey and I am a physician as well as Professor of Epidemiology and Professor of Pathology and Laboratory Medicine at Brown University. I'm speaking to you today in my capacity as a member of a committee formed by the National Academies of Sciences, Engineering, and Medicine (National Academies) that completed the most recent in a series of reports—published in November 2018—assessing the evidence between exposure to Agent Orange and the other herbicides used in the Vietnam War and adverse health effects. I also served on the committees responsible for three previous reports in this series.

The National Academy of Sciences was created more than 150 years ago through a congressional charter signed by Abraham Lincoln in order to serve as an independent, authoritative body outside the government that could advise the nation on matters pertaining to science and technology. Every year, approximately 6,000 Academies members and volunteers serve pro bono on consensus study committees or convening activities. The National Academies do not advocate for specific policy positions. Rather, they enlist the best available expertise across disciplines to examine the evidence, reach consensus, and identify a path forward. National Academies reports, proceedings and other publications are available via the web in PDF form without charge.

The National Academies have a long history of advising the federal government on the health effects of military service in general and on the effects of in-theater exposures resulting from military activities in particular. In addition to the 12-report *Veterans and Agent Orange* (VAO) series, there have also been several focused reports that have examined the effects of herbicide exposures in Vietnam veterans. A list of the National Academies reports related to health issues in Vietnam veterans is included in the materials I have submitted for the committee's attention.

I'd now like to address the National Academies' most recent findings on this topic. I was asked to focus my testimony on the epidemiologic evidence of exposure to the herbicides and hypertension.

From 1962 to 1971, the U.S. military sprayed herbicides over Vietnam for tactical purposes. The most-used chemical mixture sprayed was Agent Orange, which at the time of use was contaminated with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), the most toxic form of dioxin.

Concerns from Vietnam veterans about their own—and their children's—health, as well as emerging evidence on ill effects of exposure to Agent Orange, led Congress to enact the Agent Orange Act of 1991, which directed the U.S. Department of Veterans Affairs (VA) to ask the National Academies to comprehensively evaluate scientific and medical information regarding the health effects of exposure to Agent Orange, other herbicides used in Vietnam, and the various components of those herbicides, including TCDD. The first report was published in 1994, and Congressionally mandated updates were published approximately every 2 years since. The most recent report, *Update 11 (2018)*, presents the committee's analysis of peer-reviewed, scientific reports published between September 30, 2014, and December 31, 2017.

For each association between a specific health outcome and exposure to TCDD and other chemicals present in the herbicides used by the military in Vietnam, the study committee was asked to consider three factors: whether a statistical association with herbicide exposure exists, taking into account the strength of the scientific evidence and the appropriateness of the statistical and epidemiologic methods used to detect the association; the increased risk of disease among those exposed to herbicides during service in the Republic of Vietnam during the Vietnam era; and whether there exists a plausible biological mechanism or other evidence of a causal relationship between herbicide exposure and the disease.

In accord with Congress's mandated presumption of herbicide exposure of all Vietnam veterans, VAO committees have used Vietnam-veteran status as a proxy for herbicide exposure when no more specific exposure information is available. To anticipate the health conditions associated with aging and to obtain additional information potentially relevant to the evaluation of health effects in Vietnam veterans, the committees have reviewed studies of other groups potentially exposed to the constituents present in the herbicide mixtures used in Vietnam.

VAO committees classify the strength of the evidence regarding the association between exposure to the chemicals of interest and health outcomes into four categories: sufficient, limited or suggestive, inadequate or insufficient, and no association. The classifications are based on the committee's evaluation of the epidemiologic literature and reflect their judgment of the relative certainty of the association between the outcome and exposure to the herbicides used in Vietnam or to any of their components or contaminants. The assessment of the evidence for each presented health outcome, also takes into account information from the already-established

evidence base. Over the sequence of reviews, evidence has accrued and resulted in reclassifying several health outcomes into a different category of association.

As mandated by the Agent Orange Act, the distinctions among categories are based on statistical association and not on strict causality. Our committee was directed to review the scientific data, not to recommend VA policy; therefore, the conclusions reported are not intended to imply or suggest policy decisions. The conclusions are related to the associations between exposure and outcomes in human populations, not to the likelihood that any individual's health problem is associated with or caused by the herbicides in question. A summary of our conclusions regarding the strength of evidence for all outcomes considered and definitions of the classifications is presented in the "Summary Table" document that is included in the materials submitted for this committee's attention.

Among the findings, the National Academies' committee concluded that the available medical and scientific information constitutes sufficient evidence of an association between exposure to at least one of the chemicals of interest and hypertension. Hypertension, which was defined as blood pressure above 140/90 mmHg when the reviewed studies were published, affects more than 70 million adult Americans and is a major risk factor for coronary heart disease, myocardial infarction, stroke, and heart and renal failure. The major quantifiable risk factors for hypertension are well established and include family history, age, sex, race, obesity, reduced nephron number, high dietary salt intake, tobacco use, excessive alcohol intake, and physical inactivity. The strongest conclusions regarding a potential increase in the incidence of hypertension come from studies that have controlled for these risk factors. The Centers for Disease Control and Prevention estimates that in the United States, 64% of men and 69% of women ages 65–74 years have hypertension.

The National Academies' committee responsible for the *Update 2006* report began evaluating hypertension separately from other circulatory diseases and concluded that there was limited or suggestive evidence of an association with exposure to the chemicals and herbicides of interest. That decision was based primarily on consistent evidence from several studies of Vietnam veterans that consistently reported an association between increased levels of serum dioxin and increased prevalence of hypertension. Other studies of U.S. Vietnam veterans that did not use serum dioxin concentrations as markers of exposure also reported an increased

prevalence of hypertension associated with presumed exposure to herbicides. Additional evidence reviewed by the committees responsible for *Update 2008*, *Update 2010*, *Update 2012*, and *Update 2014* reaffirmed that level of evidence of association. The studies of Vietnam veteran cohorts from other nations and occupational cohorts reviewed by previous VAO Update committees had mixed results, with reports of both increased and decreased risk, but few reached the level of statistical significance. Similar mixed and not statistically significant findings were reported for the studies of other exposed populations that have been reviewed. A summary of the results from epidemiologic studies related to circulatory disorders, including hypertension, that have been reviewed in the VAO series have been included in the materials submitted for the committee's attention.

The *Update 11* committee reviewed six new studies of exposure to the chemicals of interest and hypertension that had been published since the previous update. The decision to change the classification from limited or suggestive evidence of an association to sufficient evidence of an association by the *Update 11* committee was motivated in large part by a 2016 paper by VA researchers Yasmin Cypel and colleagues[1]. These investigators conducted a study of U.S. Vietnam veterans (specifically, the Army Chemical Corps [ACC]), that was characterized by a large sample size, appropriate controls, and validated health endpoints. The statistical analyses conducted were robust, included several levels of exposure (herbicide sprayers and non-sprayers and Vietnam-deployed and non-Vietnam-deployed) used state-of-the-art methods, and adjusted for relevant confounders. The study clearly showed that self-reported hypertension rates were the highest among those military personnel with the greatest opportunity for exposure to the chemicals of interest: 81.6% for Vietnam-deployed sprayers compared with 77.4% of non-Vietnam deployed sprayers, 72.2% for Vietnam-deployed non-sprayers, and 64.6% for non-Vietnam-deployed non-sprayers (64.6%). Among Vietnam-deployed veterans, there was a statistically significantly elevated association between the odds of hypertension for sprayers versus non-sprayers that remained after an adjustment for potential confounders. Similarly, for those veterans who did not deploy to Vietnam, self-reported hypertension was significantly elevated among sprayers compared with non-sprayers.

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[1] Cypel YS, Kress AM, Eber SM, Schneiderman AI, Davey VJ. Herbicide Exposure, Vietnam Service, and Hypertension Risk in Army Chemical Corps Veterans. *J Occup Environ Med.* 2016;58(11):1127-1136. doi:10.1097/JOM.0000000000000876.

Although serum TCDD concentrations were not available for all participants and were collected at least 25 years after Vietnam-era service, for those with serum TCDD levels available, self-reported herbicide spray status had high agreement with the measured levels. The highest mean serum TCDD level was observed among sprayers deployed to Vietnam, and the lowest mean TCDD level was found for non-Vietnam non-sprayers, as would be expected, with a significant dose–response association. Likewise, there was high agreement (89%) between self-reported hypertension and in-person blood pressure measurements and medical records review for a subsample of study participants. The analyses controlled for important risk factors for hypertension, including age, race (white versus others), body mass index, tobacco smoking status, rank, Vietnam service status, and alcohol intake, but did not collect information on (and therefore did not control for) other risk factors such as diabetes, a family history of hypertension, and dietary intake of sodium and fat. A major strength of this analysis was using the non-Vietnam-deployed ACC veterans as a comparison group because they were similar to members of the study group with respect to branch, length and time period of service, military occupation, and duties except for deployment in Vietnam, which has the effect of minimizing unmeasured exposures and confounders of concern and bias. Additionally, because all of the men who served in ACC units were stationed at Fort McClellan for at least some time, and Fort McClellan is in close proximity to Anniston, Alabama, where Monsanto operated a plant that produced polychlorinated biphenyls, which have activity related to dioxin, all ACC veterans were likely exposed to at least low levels of these and other chemicals. Therefore, comparisons using deployed and non-deployed ACC men are likely to be biased toward the null due to this baseline of increased exposure, but despite that, the adjusted effect estimate when Vietnam-deployed sprayers were compared with non-Vietnam deployed non-sprayers was still more than twice as high, precise, and statistically significant. Although the exact types and quantities of the various chemicals these ACC veterans were possibly exposed to during the Vietnam War are unknown and may include chemicals other than the herbicides (such as insecticides, diesel and jet fuels, cleaning solvents, tear gas, napalm, and antimalarial medications), there is statistically significant support for an association between herbicide exposure and self-reported, physician-diagnosed hypertension.

The five additional epidemiologic studies reviewed in *Update 11* that examined hypertension as an outcome were two occupational and three environmental exposure investigations. Each of

these has one or more significant study design deficiencies as compared to the Cypel and colleagues analysis and would not be considered adequate to change the level of association individually. However, at least a portion of the effect model results corroborate the positive, elevated risk between exposure to the chemicals of interest and hypertension using a variety of study designs, populations, and measurements of exposure. Recent biological mechanistic research reviewed by our committee also showed evidence for dioxin's impact on hypertension via effects on gene expression, vascular function, and lipid glucose metabolism. Therefore, when the totality of evidence was considered, we found that this body of literature constituted sufficient evidence of an association.

This is only a brief summary of our work—the complete *Update 11* report is available for free download in PDF format from the National Academies Press website: nap.edu. I've also submitted a copy of the report highlights with my testimony today.

Thank you for the opportunity to testify. I would be happy to address any questions that you might have.

Additional Documents Accompanying Testimony:

Reports from the National Academies of Sciences, Engineering, and Medicine that Assess Exposure to Herbicides or Health Outcomes Among Vietnam Veterans

Table: Summary of All Outcomes Addressed in *Veterans and Agent Orange: Update 11* by category of association

Summary of the results from epidemiologic studies related to circulatory disorders that have been reviewed in the *VAO* series

Veterans and Agent Orange: Update 11 Report Highlights

Reports from the National Academies of Sciences, Engineering, and Medicine that Assess Exposure to Herbicides or Health Outcomes Among Vietnam Veterans

Veterans and Agent Orange: Update 11 (2018)	2018
Veterans and Agent Orange: Update 2014	2016
The Air Force Health Study Assets Research Program	2015
Post-Vietnam Dioxin Exposure in Agent Orange-Contaminated C-123 Aircraft	2015
Veterans and Agent Orange: Update 2012	2014
Blue Water Navy Vietnam Veterans and Agent Orange Exposure	2011
Veterans and Agent Orange: Update 2010	2011
Veterans and Agent Orange: Update 2008	2009
The utility of proximity-based herbicide exposure assessment in epidemiologic studies of Vietnam veterans	2008
Veterans and Agent Orange: Update 2006	2007
Disposition of the Air Force Health Study	2006
Veterans and Agent Orange: Update 2004	2005
Veterans and Agent Orange: Length of presumptive period for association between exposure and respiratory cancer	2004
Veterans and Agent Orange: Update 2002	2003
Characterizing exposure of veterans to Agent Orange and other herbicides used in Vietnam: Interim findings and recommendations	2003
Characterizing exposure of veterans to Agent Orange and other herbicides used in Vietnam: Final report	2003
Veterans and Agent Orange: Herbicide/dioxin exposure and acute myelogenous leukemia in the children of Vietnam veterans	2002
Veterans and Agent Orange: Update 2000	2001
Veterans and Agent Orange: Herbicide/dioxin exposure and type 2 diabetes	2000
Veterans and Agent Orange: Update 1998	1999
Characterizing exposure of veterans to Agent Orange and other herbicides used in Vietnam: Scientific considerations regarding a request for proposals for research	1997
Veterans and Agent Orange: Update 1996	1996
Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam	1994
The effects of exposure to Agent Orange on ground troops in Vietnam: A report of the subcommittee appointed to review a protocol	1982
Review of U.S. Air Force protocol: Epidemiological investigation of health effects in Air Force personnel following exposure to Herbicide Orange	1980

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IOM. 2001. Veterans and Agent Orange: Update 2000. Washington, DC: National Academy Press.
IOM. 2002. Veterans and Agent Orange: Herbicide/dioxin exposure and acute myelogenous leukemia in the children of Vietnam veterans. Washington, DC: The National Academies Press.
IOM. 2003a. Characterizing exposure of veterans to Agent Orange and other herbicides used in Vietnam: Interim findings and recommendations. Washington, DC: The National Academies Press.
IOM. 2003b. Characterizing exposure of veterans to Agent Orange and other herbicides used in Vietnam: Final report. Washington, DC: The National Academies Press.
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TABLE 42 Selected Epidemiologic Studies—Circulatory Disorders (Shaded entries are new information for Update 11 [2018])[a]

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
VIETNAM VETERANS			
US Vietnam Veterans			
US Air Force Health Study—Ranch Hand veterans vs SEA veterans (unless otherwise noted)		**All COIs**	
Through 1999—Ranch Hand personnel (n = 1,262) vs SEA veterans (n = 19,078)—circulatory disease—mortality			*Ketchum and Michalek, 2005*
Ranch Hand subjects vs all SEA veterans			
Pilots and navigators	18	1.1 (0.7–1.8)	Not adjusted for known risk factors
Administrative officers	2	1.8 (0.4–7.8)	
Enlisted flight engineers	6	0.5 (0.2–1.1)	
Ground crew	40	1.7 (1.2–2.4)	
Atherosclerosis	28	1.7 (1.1–2.5)	
Hypertensive disease	2	2.5 (0.6–10.8)	
Stroke	5	2.3 (0.9–6.0)	
Subjects with serum TCDD measures			Adjusted for smoking and family history of heart disease
SEA comparison group	31	1.0	
Background (0.6–10.0 ppt)	8	0.8 (0.4–1.8)	
Low (10.0–29.2 ppt)	12	1.8 (0.9–3.5)	
High (18.0–617.8 ppt)	9	1.5 (0.7–3.3)	
US VA Cohort of Army Chemical Corps—Expanded as of 1997 to include all Army men with chemical MOS (2,872 deployed vs 2,737 nondeployed) serving during Vietnam era (07/01/1965–03/28/1973)		**All COIs**	
Self-reported circulatory disorders diagnosed by doctor			
2013 Mail or CATI health survey of 3,086 ACC veterans			*Cypel et al., 2016*
Hypertension ORs and 95% CIs, adjusted for Vietnam service status, rank, age at the time of the survey, tobacco use, alcohol use, race, and BMI			
Herbicide sprayer vs non-sprayer	1,085	1.74 (1.44–2.11)	
Vietnam service vs no service	1,146	1.26 (1.05–1.53)	
Vietnam sprayers vs Vietnam nonsprayers	740	1.77 (1.35–2.30)	
non-Vietnam sprayers vs non-Vietnam nonsprayers	345	1.72 (1.31–2.26)	
Vietnam sprayers vs non-Vietnam sprayers	740	1.29 (0.95–1.74)	
Vietnam nonsprayers vs non-Vietnam nonsprayers	406	1.25 (0.99–1.59)	
Vietnam nonsprayers vs non-Vietnam sprayers	406	0.73 (0.53–0.99)	
Vietnam sprayers vs non-Vietnam nonsprayers	740	2.21 (1.76–2.77)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
CATI survey of stratified sample: 1,499 deployed (795 with TCDD measured) vs 1,428 nondeployed (102 with TCDD measured)			*Kang et al., 2006* Diagnoses not confirmed by medical record review. Adjusted for age, race, rank, BMI, and smoking. Serum TCDD levels measured in subset of subjects; self-reported sprayers had significantly higher concentrations, so that category regarded as valid surrogate for elevated exposure
Vietnam veterans vs non-Vietnam veterans			
Hypertension requiring medication	496	1.1 (0.9–1.3)	
Heart disease diagnosed by physician	243	1.1 (0.9–1.4)	
Sprayers vs nonsprayers			
All (diabetics, nondiabetics)			
Hypertension requiring medication	247	1.3 (1.0–1.6)	
Heart disease diagnosed by physician	129	1.4 (1.1–1.9)	
All veterans, contribution of spraying to logistic regression model			
All (diabetics, nondiabetics)			
Hypertension requiring medication		1.3 (1.1–1.6)	
Heart disease diagnosed by physician		1.5 (1.2–1.9)	
Nondiabetics only			
Hypertension requiring medication		1.2 (1.0–1.5)	
Heart disease diagnosed by physician		1.5 (1.1–2.0)	
Controlling for diabetic status			
Hypertension requiring medication		1.3 (1.0–1.6)	
Heart disease diagnosed by physician		1.5 (1.1–1.9)	
Mortality—Circulatory disorders			
Vietnam veterans vs non-Vietnam veterans—through 2005			*Cypel and Kang, 2010*
Deaths, causes of deaths from national death registries. Adjustment for race, rank duration of service, and age			
Circulatory system disease	184	1.2 (0.9–1.6)	
Hypertension	5	0.9 (0.2–3.9)	
Cerebrovascular disease	27	1.5 (0.7–3.3)	
Sprayers vs nonsprayers (subset studied in Kang et al., 2006)			
Circulatory system disease	ns	1.2 (0.6–2.3)	
Hypertension	ns	2.4 (0.2–28.5)	
Cerebrovascular disease	ns	2.1 (0.4–12.3)	
894 ACC members assigned to Vietnam in 1966–1971—1987 (vs US male population)			*Thomas and Kang, 1990*
Circulatory diseases (ICD 390–458)	6	0.6	Not adjusted for known risk factors
US CDC Vietnam Experience Study—Cross-sectional study, with medical examinations, of Army veterans: 9,324 deployed vs 8,989 nondeployed		**All COIs**	
Incidence			
Deployed vs nondeployed			*CDC, 1988a*
Hypertension after discharge			Not adjusted for known risk factors
Interviewed	2,013	1.3 ($p < 0.05$)	
Examined	623	1.2 ($p < 0.05$)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Mortality			
Deployed vs nondeployed (1965–2000)	185	1.0 (0.8–1.2)	*Boehmer et al., 2004*
Circulatory disease			
Year of death			
1970–1984	nr	0.6 (0.3–1.2)	Adjusted for age, race, military occupation
1985–2000 (partition at 1970 arbitrary)	nr	1.1 (0.9–1.3)	
Discharged before 1970	nr	0.8 (0.6–1.1)	
Discharged after 1970	125	1.4 (1.0–2.0)	
Ischemic heart disease			
0–15 years since discharge	8	0.8 (0.3–1.6)	
> 15 years since discharge	117	1.1 (0.9–1.5)	
US VA Proportionate Mortality Study—sample of deceased male Vietnam-era Army and Marine veterans who served 7/4/1965–3/1/1973		**All COIs**	
1965–1988—mortality (PMR)			*Watanabe and Kang, 1996*
Served in Vietnam vs never deployed to SEA			
Circulatory disease			Not adjusted for known risk factors
Army	5,756	0.97 ($p > 0.05$)	
Marine Corps	1,048	0.92 ($p < 0.05$)	
US VA Study of Male Vietnam Veterans Wounded in Combat		**All COIs**	
Mortality through 1981—US wounded Vietnam veterans vs US men (focus on suicide)			*Bullman and Kang, 1996*
Circulatory disease	246	0.7 (0.6–0.9)	
US VA Cohort of Female Vietnam-era Veterans served in Vietnam (n = 4,586; nurses only = 3,690); nondeployed (n = 5,325; nurses only = 3,282)		**All COIs**	
Mortality (deployed vs nondeployed)			
Through 2010—Vietnam-era veterans			*Kang et al., 2014*
Heart disease (angina pectoris, myocardial infarction, coronary artery disease, congestive heart failure) (n = 451)	167	0.8 (0.7–1.0)	
Cerebrovascular disease (total n = 94)	36	0.9 (0.6–1.3)	
Hypertension (total n = 12)	5	0.7 (0.2–2.3)	
Vietnam nurses only			
Heart disease (angina pectoris, myocardial infarction, coronary artery disease, congestive heart failure) (total = 343)	na	0.8 (0.6–1.0)	
Cerebrovascular disease (total n = 68)	na	0.8 (0.5–1.3)	
Hypertension (total n = 8)	na	0.7 (0.2–3.1)	
Through 2004—mortality			*Cypel and Kang, 2008*
Circulatory system diseases			Adjusted for duration of service, year of birth, race
Vietnam vs non-SEA veterans	129	0.8 (0.6–1.0)	
Nurses only	102	0.8 (0.6–1.0)	
US American Legion Cohort		**All COIs**	
American Legionnaires serving during Vietnam era—morbidity			*Stellman SD et al., 1988b*
Service in SEA vs not, with medically diagnosed			Not age adjusted
High blood pressure	592	1.1 ($p > 0.05$)	
Heart disease	97	1.5 ($p < 0.05$)	Age adjusted

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
State Studies of US Vietnam Veterans			
Massachusetts Vietnam-era veterans—(1958–1973)—mortality (1972–1983); deployed vs nondeployed			*Kogan and Clapp, 1985* (state report)
Deaths 1972–1983 (PMR)			Not adjusted for age; VVs thought to be younger
Circulatory system (except cerebrovascular)	139	0.9 ($p > 0.05$)	
Cerebrovascular	28	1.1 ($p > 0.05$)	
Deaths 1978–1983 (PMR)			Expected less "diluted" effect for later time
Circulatory system (except cerebrovascular)	85	0.8 ($p < 0.05$)	
Cerebrovascular	19	1.6 ($p < 0.05$)	
Wisconsin Vietnam-era veterans—923 white male Vietnam veteran's with **Wisconsin** death certificate (1968–1978) vs proportions for Vietnam-era veterans (all diseases of circulatory system)			*Anderson et al., 1986a,b*
White male Vietnam veterans vs	100		
National population		0.69 ($p < 0.05$)	
State population		0.62 ($p < 0.05$)	
Non-veterans		0.58 ($p < 0.05$)	
All veterans		0.86 ($p > 0.05$)	
Vietnam-era veterans		1.0 (0.8–1.2)	
International Vietnam Veteran Studies			
Australian Vietnam Veterans—58,077 men and 153 women served on land or in Vietnamese waters during 5/23/1962–7/1/1973 vs Australian population		**All COIs**	
Mortality—All branches, return–2001			
Circulatory disease	1,767	0.9 (0.8–0.9)	*ADVA, 2005a*
1963–1979	186	0.7 (0.6–0.8)	
1980–1990	546	0.9 (0.8–1.0)	Pattern of increasing risks with time could indicate dissipation of healthy warrior effect
1991–2001	1,035	0.9 (0.9–1.0)	
Ischemic heart disease	1,297	0.9 (0.9–1.0)	
1963–1979	124	0.7 (0.6–0.8)	
1980–1990	421	1.0 (0.9–1.0)	
1991–2001	753	1.0 (0.9–1.1)	
Stroke	223	0.8 (0.7–0.9)	
1963–1979	35	0.8 (0.5–1.1)	
1980–1990	59	0.7 (0.5–0.9)	
1991–2001	129	0.8 (0.7–1.0)	
1980–1994			*CDVA, 1997a*
Circulatory disease		1.0 (0.9–1.1)	Not adjusted for known risk factors
Ischemic heart disease		1.0 (0.9–1.1)	
Cerebral hemorrhage		0.8 (0.5–1.2)	
Sample of 1,000 Male Australian Vietnam Veterans—prevalence		**All COIs**	
450 interviewed 2005–2006 vs respondents to 2004–2005 national survey			*O'Toole et al., 2009*
Hypertensive disease	192	1.1 (1.0–1.3)	
Ischemic heart disease			Prevalence ratios calculated with age-adjustment
Angina	44	2.3 (1.7–3.0)	
Without angina	59	4.1 (3.1–5.0)	
Cerebrovascular disease	12	2.4 (1.2–3.5)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
641 interviewed 1990–1993 vs respondents to 1989–1990 national survey			*O'Toole et al., 1996b*
Hypertensive disease	nr	2.2 (1.7–2.6)	
Heart disease	nr	2.0 (0.9–3.1)	
Other circulatory diseases	nr	2.4 (1.6–3.2)	
Australian Conscripted Army National Service (18,940 deployed vs 24,642 nondeployed)		**All COIs**	
Mortality			
1966–2001			*ADVA, 2005c*
Circulatory disease	208	1.1 (0.9–1.3)	
Ischemic heart disease	159	1.2 (0.9–1.5)	
Stroke	15	0.6 (0.3–1.2)	
1982–1994 (deployed vs nondeployed)			*CDVA, 1997b*
Circulatory disease	77	1.0 (0.7–1.3)	Not adjusted for known risk factors
Ischemic heart disease	57	1.0 (0.7–1.4)	
Cerebral hemorrhage	3	1.0 (0.1–5.7)	
Other	17	0.9 (0.4–1.7)	
New Zealand Vietnam War Veterans (2,783 male survivors of deployment in 1964–1975)		**All COIs**	
Standardized hospitalization ratio for the number first observed for a condition compared to those expected based on New Zealand national hospitalization rates			*Cox et al., 2015*
Acute myocardial infarction	331	1.16 (1.00–1.33)	
Coronary atherosclerosis	659	1.27 (1.14–1.39)	
Chest pain	350	1.35 (1.16–1.53)	
Cardiac arrest	9	1.54 (0.22–2.86)	
Dysrhythmia	261	1.27 (1.07–1.48)	
Congestive heart failure	121	1.02 (0.78–1.26)	
Acute cerebrovascular disease	170	1.31 (1.05–1.56)	
Peripheral atherosclerosis	70	1.17 (0.81–1.53)	
Aneurysm	45	1.47 (0.91–2.04)	
Phlebitis	51	1.67 (1.07–2.28)	
Syncope	100	1.47 (1.18–1.76)	
Coronary Heart Disease Mortality (1988–2008)	104	0.8 (0.7–1.0)	*McBride et al., 2013*
Korean Vietnam Veterans Health Study		**All COIs**	
Prevalence (01/2000–09/2005) (n = 111,726)			*Yi et al., 2014a*
Diseases of the circulatory system [I00–I99]			
Categorized high (n = 42,421) vs low (n = 69,305)	25,613 vs 40,518	1.0 (1.0–1.0) p = 0.937	ORs adjusted for age, military rank, smoking, drinking frequency, physical activity, domestic herbicide experience, education, household income, BMI
Hypertensive disease [I10–I13]	19,597 vs 30,701	1.0 (1.0–1.0) p = 0.715	
Essential (primary) hypertension [I10]	18,946 vs 29,619	1.0 (1.0–1.0) p = 0.908	
Ischemic heart disease [I20–I25]	8,044 vs 12,226	1.0 (1.0–1.1) p = 0.025	
Acute myocardial infarction [I21–I23]	1,248 vs 1,891	1.0 (1.0–1.1) p = 0.539	
Heart failure [I50]	1,460 vs 2,156	1.0 (1.0–1.1) p = 0.769	
Stroke [I60–I64]	4,330 vs 6,024	1.1 (1.0–1.1) p < 0.001	
Atherosclerosis [I70]	1,036 vs 1,629	1.0 (0.9–1.1) p = 0.714	
Log EOI scores			

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Diseases of the circulatory system [I00–I99]	66,131	p = 0.929	
Hypertensive disease [I10–I13]	50,298	p = 0.704	
Essential (primary) hypertension [I10]	48,565	p = 0.518	
Ischemic heart disease [I20–I25]	20,270	p = 0.012	
Acute myocardial infarction [I21–I23]	3,139	p = 0.699	
Heart failure [I50]	3,616	p = 0.402	
Stroke [I60–I64]	10,354	p < 0.001	
Atherosclerosis [I70]	2,665	p = 0.584	
Mortality (1992–2005) (n = 180, 639)			*Yi et al., 2014b*
Diseases of the circulatory system [I00–I99]	1,716 vs 1,464	1.0 (1.0–1.1)	HRs adjusted for age at
Categorized high (n = 85,809) vs low (n = 69,305)		p = 0.289	cohort entry, military rank during Vietnam service
Hypertension [I10–I13]	110 vs 82	1.2 (0.9–1.6) p = 0.278	
Ischemic heart disease [I20–I25]	437 vs 406	1.0 (0.9–1.1) p = 0.897	
Acute myocardial infarction [I21]	352 vs 347	0.9 (0.8–1.1) p = 0.383	
Cerebrovascular diseases [I60–I69]	879 vs 739	1.0 (0.9–1.1) p = 0.785	
Log EOI scores	3,180	p = 0.028	
Hypertensive disease [I10–I13]	192	p = 0.108	
Ischemic heart disease [I20–I25]	843	p = 0.729	
Acute myocardial infarction [I21]	699	p = 0.313	
Cerebrovascular diseases [I60–I69]	1,618	p = 0.353	
Korean Vietnam Veterans—morbidity		**All COIs**	
Deployed vs nondeployed (unadjusted)			
Cox-regression analysis revealed that exposure history to TCDD has not significant impact on long-term cardiac events		p = 0.736	*Kim et al., 2014*
Hospital-based study of ischemic stroke Exposed cases with deployment to Vietnam (n = 91) compared to male ischemic stroke patients 55–75 years who did not serve (n = 288)			*Han et al., 2016*
Hypertension	60	65.9% vs 72.2%, p = 0.290	
Hyperlipidemia	6	6.6% vs 24.0%, p ≤ 0.001	
Atrial fibrillation	9	9.9% vs 17.0%, p = 0.132	
Type of stroke,			
Small vessel occlusion	36	39.6 % vs 25.3 %	
Large artery atherosclerosis	26	28.6 % vs 41.7 %	
Cardio embolism	9	9.9 % vs 16.0 %	
Other	20	22.0 % vs 17.0 % 0.014 p-trend type of stroke subtype	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Hypertensive disease [I10–I13]	192	p = 0.108	*Kim JS et al., 2003*
Ischemic heart disease [I20–I25]	843	p = 0.729	Concerns: selection bias, diagnosis quality, low participation, sample pooling made TCDD concentrations useless
Acute myocardial infarction [I21]	699	p = 0.313	
Cerebrovascular diseases [I60–I69]	1,618	p = 0.353	
Deployed vs nondeployed (unadjusted)			
Valvular heart disease	8	p = 0.0019	
Congestive heart failure	5	p = 0.5018	
Ischemic heart disease	34	p = 0.0143	
Hypertension	383	2.3 (1.3–4.0)	
Adjusted for age, smoking, alcohol, BMI, education, marital status			
OCCUPATIONAL—INDUSTRIAL			
IARC Phenoxy Herbicide Cohort—Workers exposed to any phenoxy herbicide or chlorophenol (production or spraying) vs respective national mortality rates		**Dioxin, phenoxy herbicides**	
Mortality 1939–1992			*Vena et al., 1998*
All male phenoxy herbicide workers			(same dataset as *Kogevinas et al.,1997* [emphasis on cancer])
All circulatory disease (ICD 390–459)	1,738	0.9 (0.9–1.0)	
Ischemic heart disease (ICD 410–414)	1,179	0.9 (0.9–1.0)	
Cerebrovascular disease (ICD 430–438)	254	0.9 (0.8–1.0)	
Other diseases of the heart (ICD 415–429)	166	1.1 (1.0–1.3)	
All female phenoxy herbicide workers			
All circulatory disease (ICD 390–459)	48	1.0 (0.7–1.3)	Not adjusted for known risk factors
Ischemic heart disease (ICD 410–414)	24	1.1 (0.7–1.6)	
Cerebrovascular disease (ICD 430–438)	9	0.7 (0.3–1.4)	
Other diseases of the heart (ICD 415–429)	6	0.9 (0.3–2.0)	
Workers with phenoxy herbicide exposure only			
All circulatory disease (ICD 390–459)	588	0.9 (0.8–0.9)	
Ischemic heart disease (ICD 410–414)	394	0.9 (0.8–0.9)	
Cerebrovascular disease (ICD 430–438)	96	0.9 (0.7–1.1)	
Other diseases of the heart (ICD 415–429)	32	0.9 (0.8–0.9)	
TCDD-exposed workers			
All circulatory disease (ICD 390–459)	1,170	0.9 (0.9–1.0)	
Ischemic heart disease (ICD 410–414)	789	1.0 (0.9–1.0)	
Cerebrovascular disease (ICD 430–438)	162	0.8 (0.7–1.0)	
Other diseases of the heart (ICD 415–429)	138	1.2 (1.0–1.4)	
Contribution of TCDD exposure to Poisson regression analysis			Adjusted for age, timing of exposure
All circulatory disease (ICD 390–459)	1,151	1.5 (1.2–2.0)	
Ischemic heart disease (ICD 410–414)	775	1.7 (1.2–2.3)	
Cerebrovascular disease (ICD 430–438)	161	1.5 (0.8–2.9)	
British MCPA Plant—Production 1947–1982 (n = 1,545) (included in IARC cohort) and spraying 1947–1972 (n = 2,561) (not included in IARC cohort)		**MCPA**	
Mortality through 1983 (hypertensive, ischemic heart disease (ICD 401–414, 428–429)	337		*Coggon et al., 1986*
vs national rates		0.8 (0.7–0.9)	
vs rural adjustment		0.9 (0.8–1.0)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
British Production Workers at 4 plants (included in IARC cohort)		**Dioxins, but TCDD unlikely; MCPA**	*Coggon et al., 1991*
Mortality—circulatory disease	74	1.2 (0.9–1.5)	
Plant A (1975–1987)	34	1.7 (adjusted = 1.4, $p \approx 0.05$)	
Plant B (1969–1987)	5	0.95	
Plant C (1963–1987)	12	0.84	
Plant D (1969–1987)	23	0.97	
Danish Production Workers (3,390 men and 1,069 women involved in production of phenoxy herbicides unlikely to contain TCDD at 2 plants in 1947–1987) (in IARC cohort)		**Dioxins, but TCDD unlikely; 2,4-D, 2,4-DP, MCPA, MCPP**	
Incidence			
Incidence 1943–1987 (men only)			*Lynge, 1993*
Incidence 1943–1982			*Lynge, 1985*
Men			
Women			
Mortality			
Mortality 1955–2006			*Boers et al., 2012*
TCDD plasma level (HRs, by tertile)	93	1.2 (1.1–1.3)	
Background (≤ 0.4)	33	—	
Low (0.4–4.1)	6	0.9 (0.4–2.5)	
Medium (4.1–20.1)	6	1.5 (0.6–4.0)	
High (≥ 20.1)	7	2.7 (1.0–7.2)	
Dutch production workers in Plant A (549 men exposed during production 1955–1985; 594 unexposed) (in IARC cohort)		**Dioxins, 2,4,5-T, 2,4,5-TCP**	
Mortality 1955–2006 (HRs for lagged TCDD plasma levels)			*Boers et al., 2012*
Ischemic heart disease (ICD-9 120–125)	60	1.2 (1.1–1.4)	
Cerebrovascular disease (ICD-9 160–167)	24	0.9 (0.7–1.1)	
Mortality 1955–2006			*Boers et al., 2010*
Ischemic heart disease	43	1.2 (0.7–2.0)	
Accident 1963	17	1.6 (0.7–3.6)	HRs adjusted for age, year of first employment. Referent group is unexposed workers
Main production workers	9	1.0 (0.5–2.2)	
Occasionally exposed	17	1.1 (0.6–2.1)	
Cerebrovascular disease	17	1.2 (0.4–3.6)	
Accident 1963	2	0.3 (0.1–1.4)	
Main production workers	5	1.3 (0.4–4.7)	
Occasionally exposed	10	1.5 (0.5–4.3)	
Mortality 1955–1991 (549 exposed vs 482 nonexposed male workers)			*Hooiveld et al., 1998*
All circulatory disease (ICD 390–459)	45	1.4 (0.8–2.5)	
TCDD > 124 ng/kg	nr	1.5 (0.8–2.9)	Adjusted for age, timing of exposure
Ischemic heart disease (ICD 410–414)	33	1.8 (0.9–3.6)	
TCDD > 124 ng/kg	nr	2.3 (1.0–5.0)	
Cerebrovascular disease (ICD 430–438)	9	1.4 (0.4–5.1)	
TCDD > 124 ng/kg	nr	0.8 (0.2–4.1)	
Other heart disease (ICD 415–429)	3	0.7 (0.1–4.3)	
TCDD > 124 ng/kg	nr	0.4 (0.0–4.9)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Dutch production workers in Plant B (414 men exposed during production 1965–1986; 723 unexposed) (in IARC cohort)		**2,4-D; MCPA; MCPP; highly chlorinated dioxins unlikely**	
Mortality 1965–2006			*Boers et al., 2010*
Ischemic heart disease	18	1.6 (0.8–3.1)	HRs adjusted for age, year of first employment. Referent group is unexposed workers
Main production workers	5	1.7 (0.6–4.6)	
Occasionally exposed	13	1.6 (0.7–3.3)	
Cerebrovascular disease	7	1.0 (0.4–2.8)	
Main production workers	1	0.9 (0.1–7.1)	
Occasionally exposed	6	1.1 (0.4–3.2)	
German Production Workers at Bayer Plant in Uerdingen (135 men working > 1 month in 1951–1976) (in IARC cohort as of 1997) and women—no results		**Dioxins; 2,4,5-TCP**	
Mortality 1951–1992 (circulatory diseases, ICD 390–458)	12	0.7 (0.4–1.3)	*Becher et al., 1996*
German Production Workers at Bayer Plant in Dormagen (520 men working > 1 month in 1965–1989) (in IARC cohort as of 1997) and women—no results		**Dioxins; 2,4-D; 2,4,5-T; MCPA; MCPP; 2,4-DP**	
Mortality 1965–1989 (circulatory diseases, ICD 390–458)	3	0.3 (0.1–1.0)	*Becher et al., 1996*
German Production Workers at BASF Ludwigshafen Plant (680 men working > 1 month in 1957–1987) (in IARC cohort as of 1997) and women—no results		**Dioxins; 2,4-D; 2,4,5-T; MCPA; MCPP; 2,4-DP**	
Mortality 1956–1989 (circulatory diseases, ICD 390–458)	32	0.8 (0.5–1.1)	*Becher et al., 1996*
BASF Cleanup Workers from 1953 accident (n = 247); 114 with chloracne, 13 more with erythema; serum TCDD levels (not part of IARC)		**Focus on TCDD**	
Mortality—1953–1992			*Ott and Zober, 1996b*
Circulatory diseases	37	0.8 (0.6–1.2)	
< 0.1 estimated TCDD µg/kg bw	13	0.8 (0.4–1.4)	
0.1–0.99	11	1.0 (0.5–1.7)	Reliability of estimated body burden is questionable
≥ 1.0	13	0.8 (0.4–1.3)	
Ischemic heart disease	16	0.7 (0.4–1.1)	
< 0.1 estimated TCDD µg/kg bw	7	0.9 (0.3–1.8)	
0.1–0.99	4	0.7 (0.2–1.7)	
≥ 1.0	5	0.6 (0.2–1.3)	
German Production Workers at Boehringer–Ingelheim Plant in Hamburg (1,144 men working > 1 month in 1952–1984; generation of TCDD reduced after chloracne outbreak in 1954) and women—no results (in IARC cohort as of 1997)		**Dioxins; 2,4,5-T; 2,5-DCP; 2,4,5-TCP**	
Mortality 1952–2007			*Manuwald et al., 2012*
Men			
Circulatory system disease		1.2 (1.0–1.3)	
Women			
Circulatory system disease		0.7 (0.6–0.9)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Mortality 1952–1992; estimated blood PCDD, PCDF, TCDD from work history, measured in 190 of 1,189 men, divided into 4 lowest quintiles, top 2 deciles			*Flesch-Janys et al., 1995*
Estimated final PCDD, PCDF, TEQs (ng/kg)			
Circulatory disease (ICD 390–459)	156		Gas workers provide a more appropriate comparison group for the data on production workers than the national population data used in *Flesch-Janys, 1997; Flesch-Janys et al., 1998*
1.0–12.2		0.9 (0.6–1.5)	
12.3–39.5		0.9 (0.6–1.5)	
39.6–98.9		1.5 (1.0–2.2)	
99.0–278.5		1.6 (1.1–2.2)	
278.6–545.0		1.6 (1.0–2.6)	
545.1–4,361.9		2.1 (1.2–3.5)	
		p-trend < 0.01	
Ischemic heart disease (ICD 410–414)	76		
1.0–12.2		1.0 (0.5–2.0)	
12.3–39.5		1.0 (0.5–1.8)	
39.6–98.9		1.0 (0.5–1.8)	
99.0–278.5		1.1 (0.6–2.0)	
278.6–545.0		1.7 (0.9–3.3)	
545.1–4,361.9		2.7 (1.5–5.0)	
		p-trend < 0.01	
Estimated final TCDD (ng/kg)			
Circulatory disease (ICD 390–459)	156		
0–2.8		1.2 (0.8–1.8)	Not adjusted for known risk factors
2.81–14.4		0.9 (0.5–1.4)	
14.5–49.2		1.4 (0.9–2.0)	
49.3–156.7		1.6 (1.1–2.4)	
156.8–344.6		1.5 (1.0–2.4)	
344.7–3,890.2		2.0 (1.2–3.3)	
		p-trend = 0.01	
Ischemic heart disease (ICD 410–414)	76		
0–2.8		1.4 (0.8–2.4)	Potential for exposure misclassification
2.81–14.4		0.8 (0.4–1.6)	
14.5–49.2		1.2 (0.7–2.2)	
49.3–156.7		0.9 (0.5–1.8)	
156.8–344.6		1.6 (0.9–3.0)	
344.7–3,890.2		2.5 (1.3–4.7)	
		p-trend < 0.01	
New Zealand Phenoxy Herbicide Production Workers and Sprayers (1,599 men and women working any time in 1969–1988 at Dow plant in New Plymouth) (in IARC cohort)		**Dioxins; 2,4-D; 2,4,5-T; MCPA; MCPB; 2,4,5-TCP; Picloram**	
245 Workers randomly selected for study consented to send a blood sample			*'t Mannetje et al., 2018*
OR Heart Disease worked in highly exposed job, adjusted for age (continuous), gender, smoking (ever/ex/current), BMI (< 25/25–30/≥ 30/missing), Māori ethnicity	10	2.71 (0.65–11.4)	
OR Heart Disease serum TCDD ≥ 10 pg/g lipid, adjusted for age (continuous), gender, smoking (ever/ex/current), BMI (< 25/25–30/≥ 30/missing), Māori ethnicity	5	1.64 (0.41–6.57)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Mortality 1969–2004			*McBride et al., 2009*
Ever-exposed workers—stroke	15	1.1 (0.6–1.9)	
Ever-exposed workers—ischemic heart disease	61	1.1 (0.9–1.5)	
Ischemic heart disease:			Adjusted for age, sex, hire year, birth year
TCDD exposure ppt-months			
0–68.3	14	1.0 (referent)	
68.4–475.0	18	1.2 (0.6–2.6)	
475.1–2,088.7	15	1.3 (0.6–2.9)	
> 2,088.7	14	0.9 (0.4–2.4)	
Production Workers (713 men and 100 women worked > 1 month in 1969–1984)			
Mortality 1969–2000			*'t Mannetje et al., 2005*
Circulatory disease	51	1.0 (0.7–1.3)	
Hypertensive disease	0	0.0 (0.0–3.5)	Not adjusted for known risk factors
Ischemic heart disease	38	1.0 (0.7–1.4)	
All-causes (SMR)	nr	1.0 (0.8–1.2)	
Sprayers (697 men and 2 women on register of New Zealand applicators, 1973–1984)			
Mortality 1973–2000			*'t Mannetje et al., 2005*
Circulatory disease	33	0.5 (0.4–0.7)	
Hypertensive disease	1	0.8 (0.0–4.5)	Not adjusted for known risk factors
Ischemic heart disease	22	0.5 (0.3–0.8)	
All-causes (SMR)	nr	0.6 (0.5–0.8)	
(Preliminary) NIOSH Cross-Sectional Medical Study—490 workers from chemical plants in Newark, New Jersey, and Verona, Missouri, 1951–1969 (morbidity)		**Dioxin/phenoxy herbicides**	*Calvert et al., 1998*
Verified conditions			
TCDD-exposed (281) vs nonexposed (260)			Not adjusted for known risk factors
Myocardial infarction	17	1.3 (0.6–2.8)	
Current systolic hypertension	64	1.1 (0.7–1.6)	
Current diastolic hypertension	77	1.2 (0.8–1.8)	
TCDD effect vs nonexposed in logistic model.			
Self-reported, verified conditions combined			
Myocardial infarction			Adjusted for age, sex, BMI, smoking, drinking, diabetes, triglycerides, total cholesterol, HDL, family history of heart disease, and chemical plant
Serum TCDD < 238 pg/g of lipid	nr	1.1 (0.3–4.5)	
Serum TCDD ≥ 238 pg/g of lipid	nr	1.1 (0.2–5.1)	
Hypertension			
Serum TCDD < 238 pg/g of lipid	nr	1.3 (0.9–2.0)	
Serum TCDD ≥ 238 pg/g of lipid	nr	1.1 (0.6–1.9)	
Verified conditions			
Current systolic hypertension			
Serum TCDD < 238 pg/g of lipid	nr	1.1 (0.7–1.8)	
Serum TCDD ≥ 238 pg/g of lipid	nr	1.2 (0.6–2.3)	
Current diastolic hypertension			
Serum TCDD < 238 pg/g of lipid	nr	1.4 (0.9–2.1)	
Serum TCDD ≥ 238 pg/g of lipid	nr	1.0 (0.5–1.9)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
NIOSH Mortality Cohort (12 US plants, 5,172 male production and maintenance workers 1942–1984) (included in IARC cohort as of 1997)		**Dioxins, phenoxy herbicides**	
Through 1993			*Steenland et al., 1999*
Cerebrovascular disease (ICD 430–438)	69	1.0 (0.7–1.2)	Not adjusted for known
Ischemic heart disease (ICD 410–414)	456	1.1 (1.0–1.2)	risk factors
Chloracne subcohort (n = 608) vs US population; exposure subcohort (n = 3,538)	92		Adjusted for age
< 19 cumulative TCDD	nr	1.0	
19–138	nr	1.2 (0.8–2.0)	
139–580	nr	1.3 (0.8–2.2)	No units given for
581–1,649	nr	1.3 (0.8–2.1)	exposure derived from
1,650–5,739	nr	1.4 (0.9–2.2)	job-exposure matrix
5,740–20,199	nr	1.6 (1.0–2.6)	
≥ 20,200	nr	1.8 (1.1–2.9)	
		p-trend = 0.05	
		p-trend log < 0.001	
Monsanto workers (n = 240) involved in 2,4,5-T production (1948–1969) and 163 unexposed workers, results of clinical examination July 1979—morbidity		**Dioxin, phenoxy herbicides**	*Suskind and Hertzberg, 1984*
Hypertension	70	(p > 0.05)	Adjusted for age
Coronary artery disease	22	(p > 0.05)	
All Dow TCP-Exposed Workers (TCP production 1942–1979 or 2,4,5-T production 1948–1982 in Midland, Michigan) (in IARC and NIOSH cohorts)		**2,4,5-T; 2,4,5-TCP**	
1942–2003 (n = 1,615)			*Collins et al., 2009b*
Ischemic heart disease	218	1.1 (0.9–1.2)	No adjustment
Cerebrovascular disease	37	1.0 (0.7–1.4)	discussed
March 1955–1977 (n = 884 workers); mortality			*Zack and Gaffey, 1983*
Circulatory disease (ICD 390–458)	92	1.11 (p > 0.05)	Not adjusted for known
Atherosclerosis and CHD (ICD 410–413)	79	1.33 (p > 0.05)	risk factors
March 1949–1978 (n = 121); mortality—121 TCP workers with chloracne			*Zack and Suskind, 1980*
Circulatory disease (ICD 390–458)	17	0.68 (p > 0.05)	Not adjusted for known
Atherosclerosis and CHD (ICD 410–413)	13	0.73 (p > 0.05)	risk factors
All Dow PCP-Exposed Workers—all workers from the two plants that only made PCP (in Tacoma, Washington, and Wichita, Kansas) and workers who made PCP and TCP at two additional plants (in Midland, Michigan, and Sauget, Illinois)		**2,4,5-T; 2,4,5-TCP**	*Ruder and Yiin, 2011*
1940–2005 (n = 2,122)			
Rheumatic heart disease (ICD-9 390–398)	4	0.6 (0.2–1.6)	
Ischemic heart disease (ICD-9 410–414)	350	1.0 (0.9–1.2)	
Hypertension with heart disease (ICD-9 402, 404)	6	0.4 (0.2–1.0)	
Cerebrovascular disease (ICD-9 430–438)	64	1.0 (0.7–1.2)	
PCP and TCP (n = 720)			
Rheumatic heart disease (ICD-9 390–398)	0	0.0 (0.0–1.9)	
Ischemic heart disease (ICD-9 410–414)	120	1.1 (0.9–1.3)	
Hypertension with heart disease (ICD-9 402, 404)	0	0.0 (0.0–1.0)	
Cerebrovascular disease (ICD-9 430–438)	20	1.0 (0.6–1.5)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
PCP (no TCP) (n = 1,402)			
Rheumatic heart disease (ICD-9 390–398)	4	0.9 (0.3–2.3)	
Ischemic heart disease (ICD-9 410–414)	230	1.0 (0.9–1.1)	
Hypertension with heart disease (ICD-9 402, 404)	6	0.6 (0.2–1.3)	
Cerebrovascular disease (ICD-9 430–438)	44	0.9 (0.7–1.2)	
Dow 2,4-D Production Workers (1945–1982 in Midland, Michigan) (subset of all TCP-exposed workers)		**2,4-D, lower chlorinated dioxins**	
Through 1994 (n = 1,517), circulatory disease			*Burns et al., 2001*
0 years latency	158	1.0 (0.8–1.1)	
≥ 20 years latency	130	1.1 (0.9–1.2)	
Dow PCP Production Workers (1937–1989 in Midland, Michigan) (*not* in IARC and NIOSH cohorts)		**Low chlorinated dioxins, 2,4-D**	
1937–2011 Potential dioxin exposure (n = 2,192), TCP production (n = 1,419), PCP production (n = 577), Both TCP and PCP (n = 196)		**2,4,5-T; 2,4,5-TCP PCP**	*Collins et al., 2016*
TCP/PCP, Cerebrovascular disease (I60–I69)	68	1.03 (0.80–1.30)	
TCP (includes 196 PCP workers), Cerebrovascular disease (I60–I69)	49	1.07 (0.79–1.41)	
PCP (includes 196 TCP workers), Cerebrovascular disease (I60–I69)	27	1.07 (0.70–1.55)	
TCP/PCP, Ischemic heart disease (I20–I25)	371	1.10 (0.99–1.22)	
TCP (includes 196 PCP workers), Ischemic heart disease (I20–I25)	256	1.07 (0.95–1.21)	
PCP (includes 196 TCP workers), Ischemic heart disease (I20–I25)	150	1.20 (1.01–1.41)	
Mortality 1940–2004 (n = 577, excluding 196 also having exposure to TCP)			*Collins et al., 2009a*
Ischemic heart disease	99	1.0 (0.8–1.3)	No adjustment discussed
Cerebrovascular disease	17	0.9 (0.5–1.2)	
Mortality 1940–1989 (n = 770)			*Ramlow et al., 1996*
Circulatory disease (ICD 390–458)	115	1.0 (0.8–1.1)	
Arteriosclerotic heart disease (ICD 410–413)	86	1.0 (0.8–1.3)	
Cerebrovascular disease (ICD 430–438)	15	1.0 (0.6–1.7)	
Other Studies of Industrial Workers (not related to IARC or NIOSH phenoxy cohorts)			
Italy			
Trento, electric arc furnace workers (n = 331). Cohort followed from 1979–2009 (6,731 person-years)		**Dioxin (detected in foundry dust)**	*Cappelletti et al., 2016*
Ischemic heart disease (crude)	4	1.27 (0.35–3.26)	
Morbidity analysis limited to 235 living workers adjusted for age, compared to general population in Trento			
Cardiovascular Disease	5	1.74 (1.07–2.82)	
Non-complicated Hypertension	30	2.44 (1.75–3.40)	
Complicated Hypertension	14	2.22 (1.35–3.65)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Japanese Waste-Incinerator Workers—Workers exposed to PCDD at municipal waste incinerator		**Dioxin, phenoxy herbicides**	*Kitamura et al., 2000*
Hypertension by PCDD, PCDF	14 of 94	No increases observed	Adjusted for age, BMI, smoking
678 male workers from 2000–2007 at 36 waste incineration sites throughout Japan		**PCDDs**	*Yamamoto et al., 2015*
< 4.34 pg TEQ/g lipid	3	1.0 (referent)	
≥ 4.34 pg TEQ/g lipid	7	1.35 (0.84–2.19)	
≥ 6.09 pg TEQ/g lipid	10	1.16 (0.71–1.91)	
≥ 8.98 pg TEQ/g lipid	25	1.66 (1.00–2.78)	
		p-trend < 0.05	
		PCDFs	
< 2.16 pg TEQ/g lipid	3	1.0 (referent)	
≥ 2.16 pg TEQ/g lipid	7	1.34 (0.82–2.19)	
≥ 3.10 pg TEQ/g lipid	10	1.74 (1.06–2.87)	
≥ 4.51 pg TEQ/g lipid	25	1.90 (1.12–3.25)	
		p-trend < 0.05	
		Coplanar PCBs	
< 2.60 pg TEQ/g lipid	2	1.0 (referent)	
≥ 2.60 pg TEQ/g lipid	9	1.26 (0.76–2.09)	
≥ 4.45 pg TEQ/g lipid	14	1.66 (0.99–2.79)	
≥ 7.30 pg TEQ/g lipid	20	2.31 (1.33–4.02)	
		p-trend < 0.05	
		Total dioxins	
< 9.76 pg TEQ/g lipid	3	1.0 (referent)	
≥ 9.76 pg TEQ/g lipid	7	1.01 (0.62–1.66)	
≥ 13.70 pg TEQ/g lipid	10	1.62 (0.97–2.70)	
≥ 21.67 pg TEQ/g lipid	25	1.92 (1.21–3.28)	
		p-trend < 0.05	
OCCUPATIONAL—PAPER AND PULP WORKERS		**TCDD**	
IARC cohort of pulp and paper workers—60,468 workers from 11 countries, TCDD among 27 agents assessed by JEM			*McLean et al., 2006*
Exposure to nonvolatile organochlorine compounds—circulatory disease (mortality)			Not adjusted for known risk factors
Never	2,727	0.9 (0.8–1.0)	
Ever	2,157	1.0 (1.0–1.0)	
OCCUPATIONAL—HERBICIDE-USING WORKERS (not related to IARC sprayer cohorts)			
ITALIAN Licensed Pesticide Users—male farmers in southern Piedmont licensed 1970–1974			
Italian rice growers with documented phenoxy use (1960–1980)—mortality (1957–1992) (n = 1,487)		**Phenoxy herbicides**	*Gambini et al., 1997*
Myocardial infarction	67	0.7 (0.6–0.9)	
Other ischemic heart diseases	72	0.4 (0.3–0.5)	
Stroke	155	1.0 (0.8–1.1)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
THE NETHERLANDS			
Dutch Licensed Herbicide Sprayers—1,341 certified before 1980		**Herbicides**	
Through 2000			*Swaen et al., 2004*
Circulatory disease	70	0.7 (0.5–0.9)	
UNITED STATES			
US Agricultural Health Study—prospective study of licensed pesticide sprayers in Iowa and North Carolina: commercial (n = 4,916 men), private/farmers (n = 52,395, 97.4% men), and spouses of private sprayers (n = 32,347, 0.007% men), enrolled 1993–1997; followups with CATIs 1999–2003 and 2005–2010		**Phenoxy herbicides**	
Parameter estimate phenoxy herbicide exposure and 1 unit change in BMI at followup		β = 0.03 p = 0.0222	*Laverda et al., 2015*
Study of myocardial infarction			*Mills et al., 2009*
Mortality among 54,069 male applicators			
2,4-D	73	0.9 (0.7–1.1)	Adjusted for age, state, smoking. Incidence analysis further adjusted for body mass index
2,4,5-T	32	1.0 (0.8–1.2)	
2,4,5-TP	14	1.1 (0.8–1.4)	
Dicamba	42	0.9 (0.8–1.2)	
Non-fatal incidence among 32,024 male applicators—year 5 survey			
2,4-D	78	1.2 (1.0–1.4)	
2,4,5-T	37	1.2 (1.0–1.4)	
2,4,5-TP	14	1.1 (0.9–1.4)	
Dicamba	47	1.1 (0.9–1.3)	
Enrollment through 2001—mortality			*Blair et al., 2005a,b*
Private applicators (farmers), spouses			Adjusted for age, race, state, sex, and calendar year of death
Circulatory disease	619	0.5 (0.5–0.6)	
Enrollment through 2007, vs state rates			*Waggoner et al., 2011*
Applicators (n = 1,641)			
Rheumatic heart disease	8	0.7 (0.3–1.4)	
Hypertension with heart disease	40	0.5 (0.4–0.7)	
Hypertension without heart disease	15	0.4 (0.2–0.6)	
Ischemic heart disease	1,099	0.5 (0.5–0.6)	
Cerebrovascular disease	236	0.5 (0.5–0.6)	
Spouses (n = 676)			
Rheumatic heart disease	7	0.7 (0.3–1.5)	
Hypertension with heart disease	7	0.3 (0.1–0.6)	
Hypertension without heart disease	6	0.3 (0.1–0.7)	
Ischemic heart disease	211	0.5 (0.4–0.5)	
Cerebrovascular disease	105	0.6 (0.5–0.7)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
US Department of Agriculture Workers—nested case-control study of white men dying 1970–1979		**Herbicides**	
Forest conservationists		p-trend < over years worked	*Alavanja et al., 1989* Not adjusted for known risk factors
Ischemic heart disease (ICD 410–414)	543	1.0 (0.9–1.1)	
Cerebrovascular disease (ICD 430–438)	99	0.9 (0.8–1.1)	
Florida Licensed Pesticide Applicators		**Herbicides**	*Blair et al., 1983* Not adjusted for known risk factors
Pesticide applicators in Florida licensed 1965–1966 (n = 3,827)—mortality through 1976			
Circulatory diseases (ICD 390–458)			
ENVIRONMENTAL			
Seveso, Italy, Residential Cohort—Industrial accident July 10, 1976 (723 residents Zone A; 4,821 Zone B; 31,643 Zone R; 181,574 local reference group) (ICD-9 171)		**TCDD**	
25-year followup to 2001			*Consonni et al., 2008*
Zone A, sexes combined			
All circulatory diseases (ICD 390–459)	45	1.1 (0.8–1.4)	Adjusted for gender, age, period
Chronic rheumatic heart diseases (ICD 393–398)	3	5.7 (1.8–18.0)	
Hypertension (ICD 400–405)	5	2.2 (0.9–5.3)	
Ischemic heart diseases (ICD 410–414)	13	0.8 (0.5–1.4)	
Acute myocardial infarction (ICD 410)	6	0.6 (0.3–1.4)	
Chronic ischemic heart diseases (ICD 412, 414)	7	1.1 (0.5–2.3)	
Cerebrovascular diseases (ICD 430–438)	11	0.9 (0.5–1.6)	
Zone B, sexes combined			
All circulatory diseases (ICD 390–459)	289	1.0 (0.9–1.1)	
Chronic rheumatic heart diseases (ICD 393–398)	1	0.3 (0.0–2.2)	
Hypertension (ICD 400–405)	11	0.7 (0.4–1.3)	
Ischemic heart diseases (ICD 410–414)	102	1.0 (0.8–1.2)	
Acute myocardial infarction (ICD 410)	54	0.9 (0.7–1.1)	
Chronic ischemic heart diseases (ICD 412, 414)	47	1.1 (0.8–1.4)	
Cerebrovascular diseases (ICD 430–438)	101	1.2 (1.0–1.5)	
Zone R, sexes combined			
All circulatory diseases (ICD 390–459)	2,357	1.1 (1.0–1.1)	
Chronic rheumatic heart diseases (ICD 393–398)	24	1.0 (0.6–1.5)	
Hypertension (ICD 400–405)	144	1.2 (1.0–1.4)	
Ischemic heart diseases (ICD 410–414)	842	1.1 (1.0–1.1)	
Acute myocardial infarction (ICD 410)	447	1.0 (0.9–1.1)	
Chronic ischemic heart diseases (ICD 412, 414)	390	1.2 (1.0–1.3)	
Cerebrovascular diseases (ICD 430–438)	695	1.1 (1.0–1.2)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
National Health and Nutrition Examination Survey			
NHANES 1999–2004 participants over 70 years		**PCBs**	
CVD death			*Kim et al., 2015*
Tertile 1 PCB Exposure	11	referent	Adjusted for age, sex,
Tertile 2 PCB Exposure	13	1.06 (0.47–2.40)	race, smoking,
Tertile 3 PCB Exposure	26	2.37 (1.10–5.09)	physical activity, and BMI
NHANES 2011–2012—9,756 participants, 3,035 with hypertension		**2,4-D**	*Shiue et al., 2014* Adjusted for urine
OR 2,4-Dichlorophenol and hypertension		1.02 (0.88–1.19)	creatinine, age, sex,
Total arsenic		1.13 (0.99–1.29)	ethnicity, and BMI
Trimethylarsine oxide		2.47 (1.27–4.81)	
Dimethylarsonic acid		1.42 (1.12–1.79)	
NHANES 1999–2004—9,756 adults ≥ 40 years of age (1,176 males and 1,185 females) followed for mortality through 2006 (average 4.6 years)		**Dioxin, dioxin-like PCBs**	*Lin et al., 2012* Adjusted for age, gender, BMI, race, smoking, drinking
CVD [ICD-10 I00–I78]—75 deaths			
< 25th percentile (13.3 pg TEQ/g lipid)		1.0	
25th–75th percentile (13.3–27.9 pg TEQ/g lipid)		1.5 (0.6–3.4)	
>75th percentile (≥ 27.9 pg TEQ/g lipid)		1.7 (0.6–4.5)	
		p-trend = 0.59	
increase per 1 pg in dioxin TEQ/g lipid		1.1 (0.8–1.5)	
NHANES 1999–2002—newly diagnosed hypertension; 524 adults (≥ 40 years of age) excluding treated hypertensives		≥ 75th percentile vs < 25th percentile	*Ha et al., 2009*
Men			
PCDDs	23	2.3 (0.7–7.8)	
		p-trend = 0.15	
PCDFs	21	1.9 (0.7–4.9)	
		p-trend = 0.17	
Dioxin-like PCBs	27	1.7 (0.8–6.6)	Adjusted for age, race,
		p-trend = 0.11	income, BMI, cigarette
Women			smoking, serum
PCDDs	33	5.0 (1.2–21.5)	cotinine, alcohol,
		p-trend = 0.08	exercise
PCDFs	30	4.2 (1.3–14.3)	
		p-trend = 0.01	
Dioxin-like PCBs	28	1.1 (0.3–3.5)	
		p-trend = 0.93	
26.1–59.1		1.1 (0.9–1.4)	
> 59.1		1.8 (1.2–2.6)	
PCB 156 (ng/g of lipid) (TEF = 0.0005)			
≤ 12.5		1.0	
12.6–15.4		1.3 (0.9–1.9)	
> 15.4		1.2 (0.8–1.9)	
PCB 169 (pg/g of lipid) (TEF = 0.01)			
≤ 27.0		1.0	
27.1–46.4		1.1 (0.9–1.5)	
> 46.4		1.3 (0.9–1.9)	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
NHANES 1999–2002—self-reported cardiovascular disease (excluding hypertension)—889 nondiabetics ≥ 40 years of age		≥ 75th percentile vs < 25th percentile	*Ha et al., 2007*
Men			
HxCDD	18	2.5 (0.8–7.7)	Adjusted for age, race, income, BMI, cigarette smoking, serum cotinine, alcohol, exercise HDL, total cholesterol, triglycerides hypertension, C-reactive protein
HpCDD	18	2.4 (0.5–10.3)	
OCDD	16	2.1 (0.6–7.7)	
PCDDs	23	2.2 (0.8–6.1)	
PCDFs	19	0.7 (0.3–1.7)	
Dioxin-like PCBs	22	1.7 (0.6–5.5)	
Women			
HxCDD	21	2.8 (0.9–8.6)	
HpCDD	14	1.9 (0.3–10.8)	
OCDD	17	0.7 (0.2–2.8)	
PCDDs	19	2.0 (0.7–6.4)	
PCDFs	15	1.0 (0.3–2.8)	
Dioxin-like PCBs	23	5.0 (1.2–20.4)	
NHANES 1999–2004—prevalent hypertension (self-report that told by doctor, ≥ 140/90 mmHg or antihypertensive medications)—3,398–3,712 individuals depending on congener			*Everett et al., 2008b* superseded *Everett et al., 2008a* on 1999–2002 and n = 2,074–2,556
PCB 126 (ng/g of lipid) (TEF = 0.1)			
≤ 26.1		1.0	
26.2–59.1		1.1 (0.9–1.4)	
> 59.1		1.8 (1.2–2.6)	
PCB 169 (ng/g of lipid) (TEF = 0.01)			Adjusted for age, gender, race/ethnicity, smoking status, BMI, exercise, total cholesterol, family history of myocardial infarction
≤ 27.0		1.0	
27.1–46.4		1.1 (0.9–1.5)	
> 46.4		1.3 (0.9–1.9)	
PCB 118 (ng/g of lipid) (TEF = 0.0001)			
≤ 12.5		1.0	
12.6–27.5		1.4 (1.1–1.8)	
> 27.5		2.0 (1.3–3.0)	
PCB 156 (ng/g of lipid) (TEF = 0.0005)			
≤ 12.5		1.0	
12.6–15.4		1.3 (0.9–1.9)	
> 15.4		1.2 (0.8–1.9)	
NHANES 1999–2002—721 nondiabetics ≥ 20 with fasting blood samples and measured persistent organic pollutants high blood pressure (≥ 130/85 hg)	nr	≥ 75th percentile vs those with nondetectable level	*Lee et al., 2007c*
PCDDs		1.7 (1.0–3.1)	
HxCDD		1.2 (0.7–2.2)	Adjusted for age, race, sex, income, cigarette smoking, serum cotinine, alcohol consumption, exercise
HpCDD		2.6 (1.3–5.0)	
OCDD		1.1 (0.6–2.0)	
PCDFs		1.9 (1.2–3.3)	
PeCDF		1.3 (0.7–2.4)	
HxCDF		2.3 (1.3–4.0)	
HpCDF		1.4 (0.8–2.3)	
Dioxin-like PCBs		1.4 (0.8–2.7)	
PCB 74		1.2 (0.6–2.4)	
PCB 118		1.8 (1.0–3.5)	
PCB 126		2.1 (1.2–3.7)	
PCB 169		0.6 (0.3–1.1)	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
UNITED STATES			
Superfund site caused by wood-treatment facility in Pensacola, Florida—47 workers, residents—prevalence		**Dioxin/phenoxy herbicides**	*Karouna-Renier et al., 2007*
Hypertension defined by self-report, medication use, or two readings of systolic blood pressure greater than 140 mmHg or diastolic blood pressure greater than 90 mmHg		1.1 (1.1–1.2) [error likely; published OR, lower confidence limit identical to 3 decimal places]	Adjusted for age, race, sex, BMI, tobacco and alcohol use, worker status
Other International Environmental Studies			
BELGIUM			
Flemish Environment and Health Survey (2002–2006) random sample of men (n = 775) and women (n = 808) aged 50–65. Followup survey completed, November 2011, to assess health conditions.			*Van Larebeke et al., 2015*
OR doubling of (pg TEQ/g fat) ln dioxin-like activity and **atheromata**, adjusted for BMI, education, cholesterol		1.16 (0.98–1.38)	
OR 90th percentile to 10th		1.60 p = 0.083	
OR doubling of (pg TEQ/g fat) ln dioxin-like activity and **hypertension**, adjusted for BMI, education, cholesterol		1.17 (1.03–1.32)	
OR 90th percentile to 10th		1.61 p = 0.014	
OR doubling of (Ln **HCB**, ng/g fat) ln dioxin-like activity and **hypertension,** adjusted for BMI, education, cholesterol, alcohol consumption		1.43 (1.12–1.81)	
OR 90th percentile to 10th		2.02 p = 0.0038	
CANADA		**Dioxin-like PCBs**	
Inuit adults from Nunavik, Quebec (n = 315) Adjusted for age, sex, fasting glucose, total serum lipids, waist circumference, alcohol consumption, physical activity, omega-3 fatty acid, mercury, lead levels		0.9 (0.8–1.1)	*Valera et al., 2013b*
PCB 105 and hypertensive status		1.4 (1.1–1.9)	
SWEDEN			
Swedish Mammography Cohort—population-based prospective cohort of women est. 1987–1990 (n = 33,446)		**PCBs**	*Bergkvist et al., 2015*
RR myocardial infarction, PCB exposure quartiles, ng/day			
Median, ng/day 101	335	1.0 (referent)	
Median, ng/day 147	307	1.12 (0.91–1.38)	
Median, ng/day 186	279	1.20 (0.90–1.59)	
Median, ng/day 286	465	1.58 (1.10–2.25) p-trend = 0.007	

continued

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
β change in total serum cholesterol 2.7 times change in POP concentrations (ng/glipid) subsample n = 598 at age 70 and 75 years		**Dioxins, dioxin-like PCBs**	*Pennell et al., 2014* Adjusted for gender, education, physical exercise, smoking, BMI, change in BMI, total energy intake, percentage of dietary fat
OCDD		0.12 (0.004–0.23)	
PCB 105		-0.011(-0.13–0.11)	
PCB 118		0.02 (-0.11–0.15)	
PCB 156		0.05 (-0.1–0.20)	
PCB 157		0.05 (-0.1–0.20)	
PCB 189		0.03 (-0.07–0.14)	
PIVUS participants and 100 consecutive non-participants, total sample n = 732			
OR prevalent hypertension		**Dioxin-like PCBs**	*Lind et al., 2014* Adjusted for gender, BMI, smoking status, exercise, and education
Hexachlorobenzene		1.14 (0.8–1.63)	
PCB 126		1.1 (0.94–1.3)	
PCB 169		0.86 (0.63–1.17)	
PCB 105		1.23 (0.96–1.6)	
PCB 118		1.26 (0.95–1.67)	
PCB 156		0.9 (0.63–1.3)	
PCB 157		0.9 (0.65–1.26)	
PCB 189		0.87 (0.69–1.09)	
FINLAND			
Finnish fishermen (n = 6,410) and spouses (n = 4,260) registered between 1980 and 2002 compared to national statistics		**TCDD, PCBs, TEQs**	*Turunen et al., 2008*
Ischemic heart disease			Standardized mortality analysis—age adjusted
Men	269	0.7 (0.7–0.8)	
Women	62	0.7 (0.5–0.8)	
Cerebrovascular disease			
Men	67	0.7 (0.5–0.9)	
Women	46	1.0 (0.7–11.3)	
GREENLAND		**dioxin-like PCBs**	
Plasma levels of mono-ortho PCBs 105, 18, and 156 and hypertension status			
Inuit adults residing in Greenland (n = 1,614)	645	1.0 (0.9–1.2)	*Valera et al., 2013a*
Ages 18–39		1.3 (1.0–1.7)	Adjusting for age, sex, BMI, diabetes, physical activity, smoking
Ages ≥ 40 years		0.9 (0.8–1.1)	
JAPAN			
2,264 Japanese from general population not occupationally exposed to dioxins, aged 15–76 years in 2002–2008		**Total Serum TEQ**	*Nakamoto et al., 2013*
Hypertension	638		Adjusted for age, sex, smoking, drinking, region, survey year, BMI
1st quartile		1.0	
2nd quartile		1.3 (0.9–2.0)	
3rd quartile		1.5 (1.1–2.3)	
4th quartile		2.3 (1.5–3.4)	
		p-trend < 0.0001	

TABLE 42 Continued

Study Population	Exposed Cases[b]	Exposure of Interest/ Estimated Relative Risk (95% CI)[c]	*Reference*/Comments
Hyperlipidemia			
1st quartile		1.0	
2nd quartile		1.7 (1.3–2.2)	
3rd quartile		2.4 (1.8–3.3)	
4th quartile		3.4 (2.4–4.8)	
		p-trend < 0.0001	
TAIWAN			
Residents around 12 municipal waste incinerators in Taiwan—prevalence		**Dioxin/phenoxy herbicides**	*Chen HL et al., 2006*
Hypertension diagnosed by a physician	118	5.6 (1.6–19.6)	
Serum PCDD/F (TEQs in logistic model)		0.9 (0.2–3.7)	

NOTE: 2,4-D, 2,4-dichlorophenoxyacetic acid; 2,4-DP, dichlorprop; 2,4,5-T, 2,4,5-trichlorophenoxyacetic acid; 2,4,5-TCP, 2,4,5-trichlorophenol; 2,4,5-TP, 2-(2,4,5-trichlorophenoxy) propionic acid; 2,5-DCP, 2,5-dichlorophenol; ACC, Army Chemical Corps; BMI, body mass index; CDC, Centers for Disease Control and Prevention; CHD, coronary heart disease; CI, confidence interval; COI, chemical of interest; HDL, high-density lipoprotein; HpCDD, 1,2,3,4,6,7,8-heptachlorodibenzo-*p*-dioxin; HpCDF, 1,2,3,4,6,7,8-heptachlorodibenzofuran; HR, hazard ratio; HxCDD, 1,2,3,6,7,8-hexachlorodibenzo-*p*-dixion; HxCDF, 1,2,3,4,7,8-hexachlorodibenzofuran; IARC, International Agency for Research on Cancer; ICD, *International Classification of Diseases*; JEM, job-exposure matrix; MCPA, 2-methyl-4-chlorophenoxyacetic acid; MCPB, 4-(4-chloro-2-methylphenoxy)butanoic acid; MCPP, methylchlorophenoxypropionic acid; MOS, months of service; NHANES, National Health and Nutrition Examination Survey; NIOSH, National Institute for Occupational Safety and Health; nr, not reported; OCDD, 1,2,3,4,6,7,8,9-octachlorodibenzo-*p*-dioxin; OR, odds ratio; PCB, polychlorinated biphenyl; PCDD, polychlorinated dibenzo-*p*-dioxin; PCDD/F, dioxins and furans combined; PCDF, polychlorinated dibenzofuran; PCP, pentachlorophenol; PeCDF, 2,3,4,7,8-pentachlorodibenzofuran; PMR, proportional mortality ratio; ppt, parts per trillion; SEA, Southeast Asia; SMR, standardized mortality ratio; TCDD, 2,3,7,8-tetrachlorodibenzo-*p*-dixoin; TCP, trichlorophenol; TEF, toxicity equivalency factor for individual congener; TEQ, (total) toxic equivalent; VA, US Department of Veterans Affairs.

[a]New citations labeled as such and bolded; section shaded for citations with dose-response information on TCDD.

[b]Subjects male unless otherwise noted.

[c]Given when available; results other than estimated risk explained individually.

TABLE S-1 Summary of the *Eleventh Biennial Update* Findings on Vietnam-Veteran, Occupational, and Environmental Studies Regarding Scientifically Relevant Associations Between Exposure to Herbicides and Specific Health Outcomes

Sufficient Evidence of an Association

Epidemiologic evidence is sufficient to conclude that there is a positive association. That is, a positive association has been observed between exposure to herbicides and the outcome in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.[b] For example, if several small studies that are free of bias and confounding show an association that is consistent in magnitude and direction, there could be sufficient evidence of an association. There is sufficient evidence of an association between exposure to the chemicals of interest and the following health outcomes:

Soft-tissue sarcoma (including heart)
* Non-Hodgkin lymphoma
* Chronic lymphocytic leukemia (including hairy cell leukemia and other chronic B-cell leukemias)
* Hodgkin lymphoma
Chloracne
Hypertension (category change from Limited or Suggestive in *Update 2014*)
Monoclonal gammopathy of undetermined significance (MGUS) (newly considered condition)

The committee did not reach consensus on whether the evidence regarding type 2 diabetes (mellitus) was more properly classified as *Sufficient* or *Limited or Suggestive*.

Limited or Suggestive Evidence of an Association

Epidemiologic evidence suggests an association between exposure to herbicides and the outcome, but a firm conclusion is limited because chance, bias, and confounding could not be ruled out with confidence.[b] For example, a well-conducted study with strong findings in accord with less compelling results from studies of populations with similar exposures could constitute such evidence. There is limited or suggestive evidence of an association between exposure to the chemicals of interest and the following health outcomes:

Laryngeal cancer
Cancer of the lung, bronchus, or trachea
Prostate cancer
Cancer of the urinary bladder
* Multiple myeloma
* AL amyloidosis
Early-onset peripheral neuropathy
Parkinson disease (including Parkinsonism and Parkinson-like syndromes)
Porphyria cutanea tarda
Ischemic heart disease
Stroke
Hypothyroidism

The committee did not reach consensus on whether the evidence regarding type 2 diabetes (mellitus) was more properly classified as *Sufficient* or *Limited or Suggestive*.

continued

TABLE S-1 Continued

Inadequate or Insufficient Evidence to Determine an Association

The available epidemiologic studies are of insufficient quality, consistency, or statistical power to permit a conclusion regarding the presence or absence of an association. For example, studies fail to control for confounding, have inadequate exposure assessment, or fail to address latency. There is inadequate or insufficient evidence to determine association between exposure to the chemicals of interest and the following health outcomes that were explicitly reviewed:

Cancers of the oral cavity (including lips and tongue), pharynx (including tonsils), or nasal cavity (including ears and sinuses)
Cancers of the pleura, mediastinum, and other unspecified sites in the respiratory system and intrathoracic organs
Esophageal cancer
Stomach cancer
Colorectal cancer (including small intestine and anus)
Hepatobiliary cancers (liver, gallbladder, and bile ducts)
Pancreatic cancer
Bone and joint cancers
Melanoma
Non-melanoma skin cancer (basal-cell and squamous-cell)
Breast cancer
Cancers of reproductive organs (cervix, uterus, ovary, testes, and penis; excluding prostate)
Renal cancer (kidney and renal pelvis)
Cancers of brain and nervous system (including eye)
Endocrine cancers (thyroid, thymus, and other endocrine organs)
Leukemia (other than chronic lymphocytic leukemia, including hairy-cell leukemia and other chronic B-cell leukemias)
Other myeloid diseases (including myeloproliferative neoplasms)
Cancers at other and unspecified sites
Infertility
Spontaneous abortion (other than after paternal exposure to TCDD, which appears not to be associated)
Neonatal or infant death and stillbirth in offspring of exposed people
Low birth weight in offspring of exposed people
Birth defects in offspring of exposed people, including spina bifida
Childhood cancer (including acute myeloid leukemia) or other adverse health outcomes in offspring of exposed people
Neurobehavioral disorders (cognitive and neuropsychiatric)
Neurodegenerative diseases, excluding Parkinson disease
Chronic peripheral nervous system disorders
Hearing loss
Respiratory disorders (wheeze or asthma, chronic obstructive pulmonary disease, and farmer's lung)
Gastrointestinal, metabolic, and digestive disorders (changes in hepatic enzymes, liver disorders including cirrhosis, lipid abnormalities, and ulcers)
Immune system disorders (immune suppression, allergy, and autoimmunity)
Circulatory disorders (other than hypertension, ischemic heart disease, and stroke)
Endometriosis

TABLE S-1 Continued

Disruption of thyroid homeostasis (other than hypothyroidism)
Eye problems
Bone conditions
Kidney and urinary disorders (including chronic kidney disorder, differences in kidney function, nephropathy, and end stage renal disorder)
Chronic skin disorders (including skin infections and changes in skin pigmentation)

The committee used a classification that spans the full array of cancers. However, reviews for non-malignant conditions were conducted only if they were found to have been the subjects of epidemiologic investigation or at the request of the Department of Veterans Affairs. By default, any health outcome on which no epidemiologic information has been found falls into this category.

Limited or Suggestive Evidence of No Association

Several adequate studies, which cover the full range of human exposure, are consistent in not showing a positive association between any magnitude of exposure to a component of the herbicides of interest and the outcome. A conclusion of "no association" is inevitably limited to the conditions, exposures, and length of observation covered by the available studies. In addition, the possibility of a very small increase in risk at the exposure studied can never be excluded. There is limited or suggestive evidence of no association between exposure to the herbicide components of interest and the following health outcome:

Spontaneous abortion after paternal exposure to TCDD

[a]*Herbicides* indicates the following chemicals of interest: 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 or dioxin), cacodylic acid, and picloram. The evidence regarding association was drawn from veteran, occupational, and environmental cohort studies in which people were exposed to the herbicides used in Vietnam, to their components, or to their contaminants.

[b]Evidence of an association is strengthened by experimental data supporting biologic plausibility, but its absence would not detract from the epidemiologic evidence.

*The committee notes the consistency of these findings with the biologic understanding of the clonal derivation of lymphohematopoietic cancers that is the basis of the World Health Organization classification system (Campo et al., 2011; see table here: www.ncbi.nlm.nih.gov/pmc/articles/PMC3109529/table/T1, accessed May 17, 2018).

TABLE S-1 Summary of the *Eleventh Biennial Update* Findings on Vietnam-Veteran, Occupational, and Environmental Studies Regarding Scientifically Relevant Associations Between Exposure to Herbicides and Specific Health Outcomes

Sufficient Evidence of an Association

Epidemiologic evidence is sufficient to conclude that there is a positive association. That is, a positive association has been observed between exposure to herbicides and the outcome in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.[b] For example, if several small studies that are free of bias and confounding show an association that is consistent in magnitude and direction, there could be sufficient evidence of an association. There is sufficient evidence of an association between exposure to the chemicals of interest and the following health outcomes:

Soft-tissue sarcoma (including heart)
* Non-Hodgkin lymphoma
* Chronic lymphocytic leukemia (including hairy cell leukemia and other chronic B-cell leukemias)
* Hodgkin lymphoma
Chloracne
Hypertension (category change from Limited or Suggestive in *Update 2014*)
Monoclonal gammopathy of undetermined significance (MGUS) (newly considered condition)

The committee did not reach consensus on whether the evidence regarding type 2 diabetes (mellitus) was more properly classified as *Sufficient* or *Limited or Suggestive*.

Limited or Suggestive Evidence of an Association

Epidemiologic evidence suggests an association between exposure to herbicides and the outcome, but a firm conclusion is limited because chance, bias, and confounding could not be ruled out with confidence.[b] For example, a well-conducted study with strong findings in accord with less compelling results from studies of populations with similar exposures could constitute such evidence. There is limited or suggestive evidence of an association between exposure to the chemicals of interest and the following health outcomes:

Laryngeal cancer
Cancer of the lung, bronchus, or trachea
Prostate cancer
Cancer of the urinary bladder
* Multiple myeloma
* AL amyloidosis
Early-onset peripheral neuropathy
Parkinson disease (including Parkinsonism and Parkinson-like syndromes)
Porphyria cutanea tarda
Ischemic heart disease
Stroke
Hypothyroidism

The committee did not reach consensus on whether the evidence regarding type 2 diabetes (mellitus) was more properly classified as *Sufficient* or *Limited or Suggestive*.

continued

TABLE S-1 Continued

Inadequate or Insufficient Evidence to Determine an Association

The available epidemiologic studies are of insufficient quality, consistency, or statistical power to permit a conclusion regarding the presence or absence of an association. For example, studies fail to control for confounding, have inadequate exposure assessment, or fail to address latency. There is inadequate or insufficient evidence to determine association between exposure to the chemicals of interest and the following health outcomes that were explicitly reviewed:

Cancers of the oral cavity (including lips and tongue), pharynx (including tonsils), or nasal cavity (including ears and sinuses)
Cancers of the pleura, mediastinum, and other unspecified sites in the respiratory system and intrathoracic organs
Esophageal cancer
Stomach cancer
Colorectal cancer (including small intestine and anus)
Hepatobiliary cancers (liver, gallbladder, and bile ducts)
Pancreatic cancer
Bone and joint cancers
Melanoma
Non-melanoma skin cancer (basal-cell and squamous-cell)
Breast cancer
Cancers of reproductive organs (cervix, uterus, ovary, testes, and penis; excluding prostate)
Renal cancer (kidney and renal pelvis)
Cancers of brain and nervous system (including eye)
Endocrine cancers (thyroid, thymus, and other endocrine organs)
Leukemia (other than chronic lymphocytic leukemia, including hairy-cell leukemia and other chronic B-cell leukemias)
Other myeloid diseases (including myeloproliferative neoplasms)
Cancers at other and unspecified sites
Infertility
Spontaneous abortion (other than after paternal exposure to TCDD, which appears not to be associated)
Neonatal or infant death and stillbirth in offspring of exposed people
Low birth weight in offspring of exposed people
Birth defects in offspring of exposed people, including spina bifida
Childhood cancer (including acute myeloid leukemia) or other adverse health outcomes in offspring of exposed people
Neurobehavioral disorders (cognitive and neuropsychiatric)
Neurodegenerative diseases, excluding Parkinson disease
Chronic peripheral nervous system disorders
Hearing loss
Respiratory disorders (wheeze or asthma, chronic obstructive pulmonary disease, and farmer's lung)
Gastrointestinal, metabolic, and digestive disorders (changes in hepatic enzymes, liver disorders including cirrhosis, lipid abnormalities, and ulcers)
Immune system disorders (immune suppression, allergy, and autoimmunity)
Circulatory disorders (other than hypertension, ischemic heart disease, and stroke)
Endometriosis

TABLE S-1 Continued

Disruption of thyroid homeostasis (other than hypothyroidism)
Eye problems
Bone conditions
Kidney and urinary disorders (including chronic kidney disorder, differences in kidney function, nephropathy, and end stage renal disorder)
Chronic skin disorders (including skin infections and changes in skin pigmentation)

The committee used a classification that spans the full array of cancers. However, reviews for non-malignant conditions were conducted only if they were found to have been the subjects of epidemiologic investigation or at the request of the Department of Veterans Affairs. By default, any health outcome on which no epidemiologic information has been found falls into this category.

Limited or Suggestive Evidence of No Association

Several adequate studies, which cover the full range of human exposure, are consistent in not showing a positive association between any magnitude of exposure to a component of the herbicides of interest and the outcome. A conclusion of "no association" is inevitably limited to the conditions, exposures, and length of observation covered by the available studies. In addition, the possibility of a very small increase in risk at the exposure studied can never be excluded. There is limited or suggestive evidence of no association between exposure to the herbicide components of interest and the following health outcome:

Spontaneous abortion after paternal exposure to TCDD

[a]*Herbicides* indicates the following chemicals of interest: 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 or dioxin), cacodylic acid, and picloram. The evidence regarding association was drawn from veteran, occupational, and environmental cohort studies in which people were exposed to the herbicides used in Vietnam, to their components, or to their contaminants.

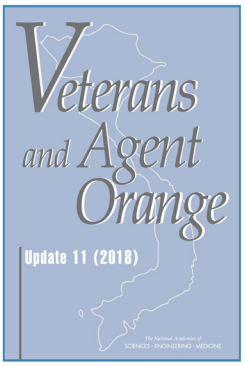
[b]Evidence of an association is strengthened by experimental data supporting biologic plausibility, but its absence would not detract from the epidemiologic evidence.

*The committee notes the consistency of these findings with the biologic understanding of the clonal derivation of lymphohematopoietic cancers that is the basis of the World Health Organization classification system (Campo et al., 2011; see table here: www.ncbi.nlm.nih.gov/pmc/articles/PMC3109529/table/T1, accessed May 17, 2018).

Consensus Study Report
November 2018
HIGHLIGHTS

Veterans and Agent Orange

Update 11 (2018)



From 1962 to 1971, the U.S. military sprayed herbicides over Vietnam to strip the thick jungle canopy that could conceal opposition forces, to destroy crops that those forces might depend on, and to clear tall grasses and bushes from the perimeters of U.S. base camps and outlying fire-support bases. The most-used chemical mixture sprayed was Agent Orange, which at the time of use was contaminated with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), the most toxic form of dioxin.

Concerns from Vietnam veterans about their own—and their children's—health, as well as emerging evidence on ill effects of exposure to Agent Orange, led Congress to enact the Agent Orange Act of 1991. This legislation directed the U.S. Department of Veterans Affairs (VA) to ask the National Academies of Sciences, Engineering, and Medicine to comprehensively evaluate scientific and medical information regarding the health effects of exposure to Agent Orange, other herbicides used in Vietnam, and the various components of those herbicides, including TCDD. The first report, ***Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam*** (*VAO*), was published in 1994, and Congressionally mandated updates have been published approximately every 2 years since.

This report, ***Veterans and Agent Orange: Update 11 (2018)***, presents the committee's analysis of peer-reviewed, scientific reports published between September 30, 2014, and December 31, 2017, about associations between various health outcomes and exposure to TCDD and other chemicals in the herbicides used in Vietnam. The report also takes into account information from the existing evidence base.

ABOUT THE STUDY

The committee was asked to determine the following regarding associations between specific health outcomes and exposure to TCDD and other chemicals present in the herbicides used by the military in Vietnam:

A. whether a statistical association with herbicide exposure exists, taking into account the strength of the scientific evidence and the appropriateness of the statistical and epidemiological methods used to detect the association;

B. the increased risk of disease among those exposed to herbicides during service in the Republic of Vietnam during the Vietnam era; and

C. whether there exists a plausible biological mechanism or other evidence of a causal relationship between herbicide exposure and the disease.

The committee was also asked to specifically examine current research available on possible generational health effects, myeloproliferative neoplasms, and glioblastoma multiforme that may be the result of exposures to these chemicals. Importantly, the committee worked independently of the VA and other governmental organizations. It was not asked to, nor did it, make judgments about specific injury cases or provide input on potential compensation policy decisions.

For detailed information about the publications examined by the committee, please visit nationalacademies.org/VeteransAgentOrange2018.

COMMITTEE'S FINDINGS AND RECOMMENDATIONS

VAO committees classify the strength of the evidence regarding the association between exposure to the chemicals of interest and health outcomes into four categories: sufficient, limited or suggestive, inadequate or insufficient, and no association. The classifications are based on the committee's evaluation of the epidemiologic literature and reflect their judgment of the relative certainty of the association between the outcome and exposure to the herbicides used in Vietnam or to any of their components or contaminants.

For a summary of the committee's findings and definitions of the classifications, please see the "Summary Table" document at nationalacademies.org/VeteransAgentOrange2018.

Among the findings, the committee concludes that the information now assembled constitutes sufficient evidence of an association between exposure to at least one of the chemicals of interest and hypertension. This finding is based in part on a recently published study of U.S. Vietnam veterans that found that self-reported hypertension rates were highest among former military personnel who had the greatest opportunity for exposure to these chemicals. The committee also concludes that there is sufficient evidence of an association between exposure and monoclonal gammopathy of undetermined significance, a clinically silent condition that is a precurser to the cancer multiple myeloma.

Relatively few studies have been conducted on the health effects of paternal chemical exposures on their descendants. None to date address Vietnam veterans specifically, and almost all available research was conducted on other populations and has weaknesses that limit its usefulness when assessing risks for veterans. For this reason, the committee strongly believes that more work in this area is warranted, and it recommends further specific study of the health of offspring of male Vietnam veterans.

Myeloproliferative neoplasms and myelodysplastic syndromes are diseases of the blood cells and bone marrow. The committee's search of epidemiologic literature yielded only one relevant paper on these diseases, a study of these cancers in Vietnam veterans that was reviewed in a previous update (*Update 2014*). Because the outcome has not been subject to previous research attention and is of interest to veterans, the committee recommends that investigators examine existing databases on myeloid diseases to determine whether there are data available that would allow for an evaluation of myeloproliferative neoplasms in Vietnam veterans and others who have been exposed to dioxin and the other chemicals of interest.

After conducting a targeted search of the literature related to glioblastoma multiforme and hearing invited presentations from experts in the field, the committee concludes that the evidence of association for exposure to the chemicals of interest and glioblastoma (and other brain cancers) remains inadequate or insufficient. The committee believes it is appropriate for VA be mindful of the concerns raised about the possible association between Vietnam service and glioblastoma. But it observes that the outcome is so rare, and the information concerning herbicide exposures so imprecise, that it is doubtful that any logistically and economically feasible epidemiologic study of veterans would produce meaningful results regarding the association between exposures and the disease. For this reason, the committee recommends that epidemiologic studies of glioblastoma in Vietnam veterans should not be pursued for this purpose and that VA should instead focus on fostering advancements in other areas that may be used to inform improved treatment options.

More generally, the committee notes that although progress has been made in understanding the health effects of military herbicide exposure and the mechanisms underlying these effects, significant gaps in our knowledge remain. Many additional opportunities for progress via continuing and new toxicologic, mechanistic, and epidemiologic research exist. Such work should include efforts to gain new knowledge through the integration of information in existing Department of Defense and VA databases.

CONCLUSION

Despite many criticisms of the conduct of studies of Vietnam veterans' health, including weaknesses and shortcomings in particular papers as well as widespread issues in the literature, the committee wishes to emphasize that the difficulty in conducting research on Vietnam veteran health issues should not act as a barrier to carrying out such work. There are many questions regarding veterans' health that cannot be adequately answered by examining superficially analogous exposures and outcomes in other populations. It is only through research on veterans themselves that the totality of the military service experience can be properly accounted for.

Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides (Eleventh Biennial Update)

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To read the full report, please visit
nationalacademies.org/VeteransAgentOrange2018

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STATEMENT OF JEFFREY L. O'MALLEY,

VETERAN, UNITED STATES ARMY,

FOR PRESENTATION BEFORE

THE SENATE COMMITTEE ON VETERANS' AFFAIRS,

March 10, 2021

Chairman Tester, Ranking Member Moran, Honorable Members of the Committee:

My name is Jeff O'Malley, and I am honored to be asked to participate in today's hearing of the Committee. I would like to note the date as having special significance for me, as it is exactly fifty years from the date that I boarded the plane for Vietnam…March 10, 1971. The experiences I had during my tour, and those of all my comrades, have stayed with me for all these years.

I signed a four-year enlistment in June of 1969, committing to assignment with the Army Security Agency, and with the expectation that I would probably be sent to language school. I completed basic at Ft. Leonard Wood, and was sent to the Defense Language Institute, Southwest at Biggs Field, Ft. Bliss for the 47 week Vietnamese language course. After graduation, we were sent to an electronics course at Goodfellow Air Force Base, in San Angelo, then, Vietnam. During language school and the electronics course, our top secret security clearances were completed.

From March of 1971 to late February of 1972, I served as a voice intercept linguist for the Army Security Agency in the Republic of Vietnam. Except for a few day trips, I worked at the 8th Radio Research Field Station near Phu Bai. The base was south of Hue, and adjacent to the main bases of the 101st Airborne, Camp Eagle. The work was important, and, at times, stressful, but the unit was well run and efficient, earning two unit citations during my tour.

I returned to the United States in late 1972, was assigned to an ASA unit at Fort Hood, pending my discharge in late May. After receiving my discharge, I returned to Houston, and re-entered civilian life.

Over the years, off and on while working, I used the GI Bill to attend college, but family obligations often took precedence. I finally received my BS degree in English and History from a branch of the University of Houston system in May of 2001. I had a long stint as a loss prevention executive for retail outlets in Texas and Louisiana, worked as a fraud investigator for the State of Texas, did some teaching and was working in an alternative school run by a local school district by 2001. The job was a contract position, which usually began after enrollment reached a certain level, and it was a job with no health care provided. Several times throughout my years of work, I had jobs that did not provide adequate healthcare, but I had been blessed with good health.

In the summer of 2008, I was offered a permanent position with the alternative school, with a raise and full benefits. It was due to begin on September 1st, and I accepted. As is fairly common in southeast Texas in late summer, a hurricane arose in the Gulf, Hurricane Ike, which came ashore and took out power and caused damage, delaying the start of school. Sitting at home with no power, I decided I would try to decide on a Blue Cross provider. I took the handbook, found the doctors in my area, and started calling. After getting no answers at five or six, I realized that their power was out as well. I finally got a response from a small office that had just gotten their power back, and they invited me over to meet the doctor.

The doctor, Mary Knaus, met me at reception, and took me back. The preliminaries of height and weight and temperature she handled herself, as her nurse was not scheduled to be there yet. As she took a medical history, she said she would take my blood pressure, using the old analog method. I paid NO attention, until she said, “I think I’ll take it again…” I noticed that she was very concerned, and then she told me, “Jeff, I’m going to have you sit in the lobby. I’m going to give you a pill, then check it again. I’ve never seen a pressure that high, except in the ER when a patient presented for stroke.” She gave me a pill, and I waited. After an hour, she took the BP again and gave me another pill. She then took and in-depth history, scheduled me for blood work and a chest X-ray. She

had no clear idea of why my blood pressure was so high. She wrote me a prescription and asked me to check my blood pressure several times a day. She indicated that my pressure had been 210/120+.

I did the blood work, and the mystery continued. The chest X-ray gave us no clues either. I began work thereafter, and would, daily, have the school nurse take my blood pressure. There were a few days where I was sent home. Since my prescription was not helping much, Dr. Knaus sent me to a cardiologist, Scott Harris, who was very sure he could fix the prescription. He prescribed the four medicines I take to this day. He still could not explain why my hypertension was so severe, so he scheduled an MRI, which found a growth on my kidney, which was diagnosed as Renal Cell Carcinoma. This led to a radical right nephrectomy, and a two month recovery. When I returned to work, I found that the side effects of my medications caused me to have very little stamina, and I eventually had to resign my position. Because I lost my insurance, I applied for eligibility for VA health care, and have been very happy with the care I have received. (During my last office visit with Dr. Harris, the cardiologist, I asked why I was still on the BP medications, and he explained that, as far as he could tell, the two very serious conditions that I had discovered in the fall were unrelated, and that he had no good explanation for my hypertension.

A fellow veteran, who trained and served with me, sharing a billet for our year in Vietnam, Dan Ferguson, invited me to visit his family in Toledo, Ohio in 2015. Dan, who is an Agent Orange prostate cancer survivor, asked me if kidney cancer was one of the presumptive conditions. I had no idea what a presumptive condition was, so he and I visited his VSO, who explained that, while kidney cancer was not, that there was recent research that was looking to add four new conditions, including HYPERTENSION. After I returned to Texas, I started researching the presumptive process, and the current state of the science.

After the 2016 NAM update listed all four of the suggested presumptive conditions at the second highest level of confidence, I tried to determine what the next steps in the process would be. The election of 2016 meant there would be a new secretary at the VA, and the announcement of Dr. Shulkin seemed encouraging. Shulkin decided he would need to consider the issue and set November 1, 2017 as the date for his decision. On November 1, I checked the VA

website for an announcement, and waiter until quite late, when a rather vague statement appeared. I could not tell what the decision was, nor whether it was good news.

I did ALL the things the VA asks veterans to do. Local sources could not explain what was decided. I contacted the White House Veterans' Hotline four times, and each time was told someone would contact me. No one ever did. The fourth time I called, I was told that no information would be forthcoming. I became aware that there were members of the Senate committee who were also interested in the issue, so I watched for questions during hearings. When all else failed, I filed a FOIA request to try and find out what the VA was planning to do about the four conditions, which was originally denied. I appealed and won, and began receiving documents. Those documents have been made public. They were provided to members of the committee and the press.

The opportunity to testify before this committee, to support the effort to understand the ongoing problems resulting from the use of Agent Orange is greatly appreciated, and I look forward to taking your questions.

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STATEMENT OF
SHANE L. LIERMANN
DEPUTY NATIONAL LEGISLATIVE DIRECTOR
OF THE DISABLED AMERICAN VETERANS
FOR THE SENATE COMMITTEE ON VETERANS' AFFAIRS
MARCH 10, 2021

Chairman Tester, Ranking Member Moran, and Members of the Committee:

Thank you for inviting DAV (Disabled American Veterans) to provide testimony for the Senate Veterans' Affairs Committee hearing on "Military Toxic Exposures: The Human Consequences of War."

Mr. Chairman, the men and women who serve are often placed in situations that have long-term health effects that will impact their individual functioning, provide industrial impairments and require physical rehabilitation and future health care. When these men and women are subjected to toxins and environmental hazards, our sense of duty to them must be heightened as many of the illnesses and diseases due to these toxic exposures may not be identified for years, even decades after they have completed their service.

That is why today's hearing on military toxic exposures and the cost to veterans and their families is so important. Our testimony will address the human costs of exposures, a brief history of the different types of toxic exposures and presumptives, critical exposure and presumptive issues and our recommendations to reform the process moving forward.

THE HUMAN COST OF EXPOSURES

To fulfill DAV's service mission to America's injured and ill veterans and the families who care for them, DAV directly employs a corps of National Service Officers (NSOs), all of whom are themselves wartime service-connected disabled veterans, at Department of Veterans Affairs regional offices (VARO) as well as other VA facilities throughout the nation.

Too many veterans are suffering from serious illnesses, struggling with access to VA health care and benefits, and unsuccessfully navigating complex and uncaring exposure and presumptive processes. The cost this is having on veterans, their health, their livelihood and families is incalculable. Here are just a few examples of the kinds of

challenges DAV service officers face in helping veterans exposed to toxic substances receive their earned health care and benefits.

Contaminated Water

In 2018, an Air Force veteran, at age 44, was diagnosed with stage IV lung cancer. She was never a smoker nor was she exposed to toxic smoke or fumes. Around that same time, her former spouse was diagnosed with pancreatic cancer. Neither had a family history of cancer; however, both were stationed at Kelly Air Force Base in Texas during a large part of the 90s.

After some research, she found a DOD report that acknowledged Perfluoro octane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) were found at high levels in all four ground water wells on Kelly AFB. She then established her claim for service connection for lung cancer due to the PFAS contaminated water. VA quickly denied her appeal in June 2018, as VA does not recognize this as a presumptive exposure nor that the water on Kelly AFB was contaminated.

She submitted a supplemental claim and in November 2019, VA denied her claim due to a lack of relevant evidence linking her cancer to contaminated water. She reached out to the DAV Service Office in San Antonio for an explanation of VA's denial and acknowledged she wanted to give up her case.

With DAV's assistance, she was able to obtain evidence that PFOS and PFOA could lead to serious and adverse health impacts to include cancer. She was able to obtain a private medical opinion linking her lung cancer to the contaminated water. DAV presented her appeal before a Board of Veterans' Appeals Law Judge in December 2020. Based on the evidence of record, it was determined that her lung cancer was service connected as it was related to her exposure to contaminated water at Kelly AFB. She is still receiving daily treatment for her lung cancer; however, now she is receiving 100% VA disability compensation and has access to VA health care.

Agent Orange

Theodore "Uncle Ted" Kalagian, of Tennessee, honorably served the United States Army in Vietnam and was discharged in 1973. When he reached out to DAV in 2014, Mr. Kalagian was struggling with his multiple diseases related to Agent Orange and facing a reduction in his benefits.

Mr. Kalagian filed a claim for bladder cancer due to Agent Orange in 2007 and VA denied it quickly as it was not a presumptive disease. He later developed diabetes mellitus, ischemic heart disease, and hypertension. VA also denied his hypertension as it is not a recognized presumptive disease. In 2014, when he reached out to DAV, VA was proposing to reduce the rating for severity of his ischemic heart disease. With DAV's assistance he was able to maintain his benefits. In 2017, the veteran again filed a claim for his bladder cancer, was denied, and filed a Supplemental Claim. During this

time, he developed prostate cancer, another presumptive disease for Agent Orange. With DAV assistance, his claim for prostate cancer was subsequently granted.

Mr. Kalagian's claim for bladder cancer is currently under appeal and is awaiting a hearing with the Board of Veterans' Appeals. Although Congress was able to add bladder cancer, hypothyroidism and Parkinsonism as presumptive diseases, VA still has not released any guidance on adjudicating these claims. Even once they do, Mr. Kalagian will have to wait for his requested hearing before a decision can be made. Since this change in law is considered to be under the purview of the Agency of Original Jurisdiction (AOJ), the Board may not have jurisdiction to make a decision and refer back to the AOJ. This means Mr. Kalagian will wait longer than Vietnam veterans with pending bladder cancer claims—another example of justice delayed is justice denied.

Right now this Vietnam veteran is faced with two cancers, ischemic heart disease and diabetes, all due to his Agent Orange exposure. When his appeal is resolved and granted he will be service connected for four diseases presumptively related to Agent Orange. In addition he has hypertension, which VA has refused to acknowledge as a presumptive disease to Agent Orange, although it has the highest level of positive scientific association.

Burn Pits

Ashley McNorrill served the United States Army as a JAG Officer and in 2005 deployed to Iraq and was assigned to Camp Victory in Baghdad. Ashley and husband David had married in 2008. Not long after, they looked to expand their family, but Ashley found herself experiencing unexplained pain and fertility problems.

In 2011, Ms. McNorrill was beginning to have really severe pains in her abdomen and on her right side under her rib cage. The cause was initially thought to be endometriosis, a relatively common health condition among women that causes uterine tissue to grow outside the uterus. Doctors recommended she undergo a hysterectomy. The McNorrills then pursued adoption as a path to parenthood, and on Dec. 2, 2011, they welcomed their new sons to the world, twin boys, Cole and Fletcher.

In February 2012, when the twins were only 2 months old, Ms. McNorrill went in for a hysterectomy. During the procedure, doctors found evidence of cancer. She was ultimately diagnosed with stage 4 appendiceal cancer, a rare form of the disease occurring in only one or two cases out of 1 million.

A fellow veteran advised her to investigate toxic exposures from burn pits like the large one at Camp Victory. In 2014, the McNorrills met with a DAV National Service Officer in South Carolina to find out what options were available. It had been two years since she had become ill, and her condition was worsening. With medical bills adding up and their young children requiring care, the family was struggling financially.

DAV proceeded to piece together Ms. McNorrill's VA disability claim, pulling together evidence from her deployment to Camp Victory and providing Ashley and doctors a list of toxins from burn pits that VA no longer has posted on their website and can only be found in its Adjudication Manual.

In her claim, she noted, "there was a burn pit just a few feet across from the [dining facility], and I remember that oftentimes, while [I was] waiting in line, someone would be manning the burn pit for hours, burning whatever it was they were burning." With DAV's assistance in formulating a request for medical opinion, she was able to obtain a private medical opinion linking her appendiceal cancer to the toxins emitted from the burn pit at Camp Victory.

After a lengthy claims and appeals process, VA ultimately granted service connection for her cancer and established a permanent and total VA disability rating. Shortly after receiving her decision, Ms. McNorrill died in March 2016 due to the cancer, leaving behind her husband to raise their two boys alone.

Although these three veterans were able to be successful in obtaining VA disability benefits for diseases related to toxic exposures, thousands more are not. Some toxic exposures have resultant presumptive processes with associated diseases and others do not, which complicates the claims processes as exemplified by two of the veteran's cases above. To know which exposures are considered presumptively-associated with certain health conditions and which are not, let's examine of brief history of those exposures and presumptives.

BRIEF HISTORY OF TOXIC EXPOSURES AND PRESUMPTIVES

In order to navigate forward, we must look back at the impact of chemical and toxic exposures thrust upon our military service members. In all of the instances noted below, the U.S. Government or Department of Defense (DOD) exposed military service members to toxins without being fully aware of the immediate or long-term health effects.

Mustard Gas and Lewisite

During World War II (WWII), both the Axis and Allies produced millions of tons of chemical weapons and had made massive preparations for their use. The U.S. established secret research programs to develop better chemical and toxic weapons and better methods of protecting against these poisons. At the end of WWII, over 60,000 U.S. service members had been used as human test subjects. At least 4,000 of these active military service members had participated in tests conducted with high concentrations of mustard agents or Lewisite in gas chambers or in field exercises over contaminated ground areas. The U.S. service members were intentionally exposed to mustard agents or Lewisite, from mild (a drop of agent on the arm in "patch" tests) to quite severe (repeated gas chamber trials, sometimes without protective clothing).

Not until 1991, over seventy years from mustard gas use in WWI and over fifty years from the secret testing in WWII, did the VA provide guidelines for establishing claims related to these exposures. In 1992, VA requested a study from the National Institute of Medicine (IOM), currently the National Academy of Medicine. The report, "Veterans at Risk: The Health Effects of Mustard Gas and Lewisite," was issued in 1993 and prompted an update to the regulatory provision in 1993 and 1994.

Radiation Exposure

Some of the first atomic veterans were service members who were sent to Hiroshima and Nagasaki to assist in clean-up. Approximately 255,000 troops were involved in the occupation of Hiroshima and Nagasaki. From 1946 to 1962, the United States conducted about 200 atmospheric nuclear tests. Approximately 400,000 service members were present during these atmospheric tests, whether as witnesses to the tests themselves or as post-test cleanup crews. Sworn to secrecy, many of these service members never told anyone about what they witnessed. If they told anyone that they were involved in these nuclear tests, they could have been fined up to $10,000 and tried for treason.

On October 24, 1984, nearly forty years after the exposure, the Veterans' Dioxin and Radiation Exposure Compensation Standards Act was enacted to ensure compensation to veterans and their survivors for disabilities or deaths related to exposure to ionizing radiation during atmospheric nuclear testing or the occupation of Hiroshima and Nagasaki. In May 1988, new statutory provisions expanded compensation on a presumptive basis for other radiation-exposed veterans who developed specific diseases, over twenty-five years after the last exposures from the atmospheric testing.

Agent Orange

The U.S. program, code-named Operation Ranch Hand, sprayed more than 20 million gallons of various herbicides over Vietnam, Cambodia and Laos from 1961 to 1971. The purpose was to strip the thick jungle canopy that could conceal opposition forces, to destroy crops that those forces might depend on, and to clear tall grasses and bushes from the perimeters of U.S. base camps and outlying fire-support bases. At the time of the spraying, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most toxic form of dioxin, was an unintended contaminant generated during the production of 2,4,5-T and so was present in the herbicide known as Agent Orange.

After their service, many Vietnam veterans were developing multiple illnesses and fatal diseases. It was not until the Veterans' Dioxin and Radiation Exposure Compensation Standards Act of 1984 that VA recognized presumptive service connection for an illness related to Agent Orange. In 1991, the Agent Orange Act became public law, nearly thirty years after the use of Agent Orange began and twenty years after the end of spraying.

Persian Gulf War, Undiagnosed Illnesses & Infectious Diseases

In response to the invasion of Kuwait by Iraq in August 1990, the United States led a coalition of 34 countries in Operation Desert Shield in the Persian Gulf. This was followed by Operation Desert Storm, which began in January 1991 and ended with a cease-fire in April 1991. Almost 700,000 U.S. troops were deployed to the Persian Gulf region during the height of the buildup.

Thousands returned home and began suffering from a number of serious illnesses considered related to smoke and petroleum from over 750 oil-well fires, depleted uranium, insecticides, burn pits, vaccinations including anthrax, and potentially the nerve agents, sarin and cyclosarin, as well as sand and dust particles and local environmental air pollution.

The Persian Gulf War Veterans Act of 1998, codified in title 38, United States Code, § 1118, was established to associate the numerous health effects known as Persian Gulf Illnesses, which includes unexplained chronic multisystem illnesses and symptoms. These presumptive conditions were established in less than 10 years from the first day of exposure. Subsequently, VA extended them to those who served in Operations Enduring Freedom and Iraqi Freedom.

In 2010, via regulatory rulemaking, VA added infectious diseases endemic to these areas as presumptives for service connection. Those diseases are: Brucellosis; Campylobacter jejuni; Coxiella burnetii (Q fever); Malaria; Mycobacterium tuberculosis; Nontyphoid Salmonella; Shigella; Visceral leishmaniasis; West Nile virus.

Contaminated Water at Camp Lejeune

From the 1950s through the 1980s, people living or working at the U.S. Marine Corps Base Camp Lejeune, North Carolina, were exposed to drinking water contaminated with industrial solvents, benzene, and other chemicals. The Caring for Camp Lejeune Families Act of 2012 recognized exposure and treatment for veterans and family members for 15 specific diseases.

In 2017, by regulation, the VA Secretary established eight presumptive diseases for active duty, reservists, and National Guard members who were stationed at Camp Lejeune for 30 aggregate days. These presumptives were established over 60 years from the first date of exposure and 30 years after the date of last exposure.

Although these conceded toxic exposures have established presumptive processes for them, as noted, in several instances it took over 50 years to recognize the exposures and establish presumptive disease related thereto. Next, we will discuss those exposures that do not have presumptive processes, which have all been pending for multiple years.

Fort McClellan toxins

Fort McClellan, located in Anniston, Alabama, became an Army installation in 1917, during World War I. After World War II until the base closed in 1999, it was home to the Chemical Corps and Chemical Weapons School for the United States Army. In 1953, Fort McClellan conducted "Operation Top Hat," which used military personnel to test exposure and decontamination methods that included sulfur mustard and nerve agents and in 1962, Fort McClellan added the Biological Radiological Agency.

From 1929 to 1971, a Monsanto chemical plant operated south of Fort McClellan in Anniston. Airborne polychlorinated biphenyls (PCBs) from the plant entered into the environment and the surrounding community was exposed.

Although the base closed in 1999, the 2005 National Academy of Medicine, formerly the Institute of Medicine, Report, "Contaminants in the Subsurface: Source Zone Assessment and Remediation," recognized that both the groundwater and soil were contaminated. There were 67 different disposal sites on Fort McClellan containing volatile organic compounds (VOCs) trichloroethylene (TCEs), PCBs, semi-volatile organic compound (SVOCs), pesticides, explosives, heavy metals (Pb), unexploded ordinance (UXO), radioactive sources, and non-stockpile chemical materials.

The Veterans Health Administration (VHA), via its website, has noted the existence of the toxic chemicals used at Fort McClellan and that potential exposures could have included, but are not limited to, the following: Radioactive compounds (cesium-137 and cobalt-60) used in decontamination training activities in isolated locations on base; chemical warfare agents (mustard gas and nerve agents) used in decontamination testing activities in isolated locations on base; Airborne PCBs from the Monsanto plant in Anniston.

While VA does acknowledge these potential exposures, it does not recognize any adverse health conditions associated with military service at Fort McClellan. Despite the fact that exposure to high levels of these compounds has been shown to cause a variety of adverse health effects in humans and laboratory animals, VA has arbitrarily determined that there is no evidence of exposures to those magnitudes having occurred at Fort McClellan.

Contaminated water by PFAs

The acronym ''PFAS'' relates to perfluoroalkyl and polyfluoroalkyl substances that are man-made chemicals with at least one fully fluorinated carbon atom. PFAS chemicals are found in many products, such as clothing, carpets, fabrics for furniture, adhesives, paper packaging for food, and heat-resistant/non-stick cookware. They are also present in fire-fighting foams (or aqueous film forming foam; AFFF) used by both civilian and military firefighters. They do not break down in the environment, and because they are used in the manufacturing of so many products, they are widespread internationally.

In the 1970s, DOD began using AFFF to fight fuel fires. The release of these chemicals into the environment during training and emergency responses is a major source of PFAS contamination of ground water on military bases.

In 2018, DOD examined 524 installations for two of the most prevalent PFAS chemicals in AFFF, perfluorooctane sulfonate, or PFOS, and perfluorooctanoic acid, or PFOA, and found 401 locations with some level of contamination. Twenty-four of those locations had drinking water contamination at levels higher than the Environmental Protection Agency's lifetime health advisory of 70 parts per trillion. In September 2019, the Environmental Working Group revealed that 90 more current and former Army and Army National Guard installations had levels of ground or drinking water contamination than previously indicated.

In March 2020, DOD released new data showing that more than 600 military sites have been contaminated with PFAS, far more than previously disclosed.

Toxic exposures at Karshi-Khanabad

Karshi-Khanabad Air Base, known as K2, is a former Soviet air base in southeastern Uzbekistan that shares a border with northern Afghanistan. Over 15,000 U.S. service members were deployed to the U.S. established Camp Stronghold Freedom at K2, which was used to support combat missions from 2001 to 2005.

While it was a Soviet air base, K2 contained chemical weapons, enriched uranium and soil saturated with fuels and other solvents that formed a “black goo.” Air samples at the base found elevated levels of tetrachloroethylene as well as the residuals of chemical weapons including cyanide in the showers. Other health assessment tests found the base had elevated levels of volatile organic compounds and total petroleum hydrocarbons (TPH) were detected at numerous locations throughout Stronghold Freedom. A 2002 assessment recommended not to dig “into soil contaminated with jet fuel, but those areas were populated with tents soldiers slept in and aircraft hangars, according to the declassified document. In the same year, another DOD health risk assessment found between 50 and 75 percent of personnel at Stronghold Freedom would be exposed to elevated levels of TPH.

A 2015 U.S. Army study found that veterans exposed at K2 have a 500% increased likelihood of developing cancer to include malignant melanoma and neoplasms of the lymphatic and hematopoietic tissues.

Airborne Hazards and Open Burn Pits

Veterans who served in Southwest Asia during the first Persian Gulf War as well as those serving in those locations, including Afghanistan after 9/11, have been exposed to the large scale use of burn pits.

DOD has acknowledged the vast use of burn pits to dispose of nearly all forms of waste. Several studies have indicated that veterans were exposed to burned waste products including, but not limited to: plastics, metal/aluminum cans, rubber, chemicals (such as paints, solvents), petroleum and lubricant products, munitions and other unexploded ordnance, wood waste, medical and human waste, and incomplete combustion by-products. The pits did not effectively burn the volume of waste generated, and smoke from the burn pit blew over bases and penetrated all living areas/quarters.

DOD has performed air sampling at Joint Base Balad, Iraq and Camp Lemonier, Djibouti. Most of the air samples have not shown individual chemicals that exceed military exposure guidelines. The air sampling performed at Balad and discussed in an unclassified 2008 assessment tested and detected all of the following: (1) Particulate matter; (2) Polycyclic Aromatic Hydrocarbons (PAH); (3) Volatile Organic Compounds; and (4) Toxic Organic Halogenated Dioxins and Furans (dioxins).

Although the National Academies of Science, Engineering, and Medicine (National Academies), has conducted two separate reports on burn pits and airborne hazards over the past ten years, they have yet to identify any diseases with a positive scientific association.

Understanding these current toxic exposures and presumptive processes is necessary to be able to identify the obstacles and barriers veterans face in trying to establish service connection for conditions potentially related to their military service and access to health care. Our focus is to identify these issues and provide solutions.

Critical Exposure and Presumptive Issues

DAV believes we are at a critical juncture in toxic exposures and many of the resultant presumptive processes. For most veterans, establishing service connection for a disease related to toxic exposures is their gateway to VA health care, disability compensation and ancillary benefits; however, when VA does not recognize the exposures, or have requirements on the Secretary or protections for veterans, they must struggle to establish direct service connection for their exposures and wait decades for their exposures and resultant scientifically associated diseases acknowledged by the VA.

Exposures not recognized

Millions of veterans exposed to burn pits and airborne hazards, the nerve, biological and toxic materials at Ft. McClellan, PFAS contaminated water at over 600 military installations, and the thousands at Karshi-Khanabad all must establish direct service connection claims as VA has failed to recognize their exposure to these hazards and the specific toxins with resultant presumptive processes.

In many cases, it has taken VA decades to recognize exposures and obtain scientific evidence of diseases associated. Veterans suffering with life-threatening diseases simply do not have any more time. Congress and VA must take action now to, at least, recognize and concede their exposures to toxins from burn pits, Ft. McClellan, PFAS contaminated water, and at K2.

This concept, for concession of exposure, is outlined in S. 437, the Veterans Burn Pit Exposure Recognition Act. If VA concedes veterans exposure to the specific toxins of burn pits, PFAS contaminated water or K2, veterans would have certain barriers removed in establishing direct service connection for these diseases. If the VA cannot grant based on the evidence of record, it would then request a medical opinion if the conceded exposure is "at least as likely as not" the cause of the claimed disease or disability. This does not require any additional science and can be implemented into law right now while additional scientific studies and evidence is gathered to look at possibly establishing presumptive diseases.

As exemplified by the fact that these four exposures do not yet have the requisite scientific association with diseases to establish presumptives, there are serious flaws with current presumptive processes and linking of associated diseases.

Radiation Risk Activities

It has been decades since Congress or VA has recognized additional radiation risk activities. This is a crucial element to the presumptive process for radiation exposed veterans. In order to establish service connection for a radiation disease, veterans must have participated in a recognized radiation risk activity.

Currently the VA does not recognize participation in the clean-up of Palomares, Spain for the period of January 17, 1966, to March 31, 1967, as a radiation risk activity. On January 17, 1966, a U.S. B-52G bomber collided with a KC-135 tanker during mid-air refueling. As a result of the mid-air collision, the non-nuclear explosives of two of the four hydrogen bombs carried by the bomber, detonated upon impact with the ground and ignited the pyrophoric plutonium, producing a cloud that was dispersed by a 30-knot wind. Approximately 650 acres were contaminated with radioactive material. As part of the U.S effort, active service members participated in the clean-up.

VA currently recognizes those veterans who participated in nuclear testing on Enewetak Atoll from 1951 to 1959 as participating in a radiation risk activity. However, in March 1977, the United States began decontamination of Enewetak and built a concrete dome to deposit radioactive soil and debris. Approximately 6,000 military service members participated in the cleanup project. VA does not accept the cleanup of Enewetak Atoll from January 1, 1977, to December 31, 1980, as a radiation risk activity.

Persian Gulf Illness Concerns

The Persian Gulf War Veterans Act of 1998, codified at 38 U.S.C. § 1118, originally had time-required actions by the Secretary. However, those requirements expired on October 1, 2011, as the date was not reauthorized for the future. All of this means there are no current time requirements on the Secretary to act on recommendations made by the National Academies in reference to additional diseases related to toxic exposures. This authority needs to be reauthorized by Congress.

It is extremely important to note that per 38 C.F.R. § 3.317, the delimiting date to claim disabilities under this presumptive process is December 31, 2021. We need congressional oversight to ensure VA extends this date so veterans still have access to presumptive service connection for these exposures. Furthermore, we are concerned there are no future reports required by the National Academies unless directed individually by the VA.

Agent Orange Exposure Concerns

When the Agent Orange Act of 1991 was passed into law, it contained requirements for action by the Secretary when a report and recommendations from the National Academies was received. This section of the statute included a date to discontinue this requirement. It was reauthorized several times; however, this part of the Agent Orange Act, 38 U.S.C. § 1116, expired on October 1, 2015. This means, the Secretary no longer has a required time frame for actions on recommended diseases to be added as a presumptive to Agent Orange.

The lack of the time-required action is having a negative impact on veterans and their families. The National Academies report of 2016 established that there is positive scientific association between Agent Orange exposure and the diseases, bladder cancer, hypothyroidism, and Parkinsonism. However, the Office of Management and Budget (OMB) stated that former Secretary Shulkin did not have the authority under the statute to add additional diseases followed by VA noting they needed a higher level of association and more science to add the three diseases. We thank the Senate for taking the lead on this issue and getting these three diseases added into law. However, this unnecessary delay could have been avoided.

In 2018, the National Academies reported that hypertension and monoclonal gammopathy of unspecified significance (MGUS) had their highest level of positive scientific association. Yet, VA previously stated they needed to wait on two additional pending studies before they could make a decision on these two diseases. We are calling on the Senate Veterans' Affairs Committee to again take the lead on these two additional presumptives for Agent Orange exposure.

DOD has acknowledged that Agent Orange was used at several Thailand bases during the Vietnam War. This exposure is not recognized via statute or VA regulation. It is only mentioned in the VA Adjudication Manual and is overly restrictive and concedes

exposure to only those with occupational specialties on the perimeter of the bases. We need Congress to enact legislation to codify that exposure and expand it to all U.S. service members stationed on Thailand military bases during Vietnam.

Camp Lejeune Contaminated Water Concerns

The Honoring America's Veterans and Caring for Camp Lejeune Families Act of 2012 established 15 different conditions where the exposed military personnel and their families were eligible to seek treatment at VA health facilities at no cost.

The conditions identified for cost-free health care were esophageal cancer, lung cancer, breast cancer, bladder cancer, kidney cancer, leukemia, multiple myeloma, myelodysplastic syndromes, renal toxicity, hepatic steatosis, female infertility, miscarriage, scleroderma, neurobehavioral effects, and non-Hodgkin's lymphoma.

In 2017, the VA implemented regulatory provisions for presumptive service connection for service members who served an aggregate of 30 days at Camp Lejeune from August 1, 1953 to December 31, 1987. The water supply was contaminated with the volatile organic compounds (VOC) trichloroethylene (TCE), perchloroethylene (PCE), benzene and vinyl chloride.

We are concerned with the regulatory requirement of 30 days of aggregate service at Camp Lejeune. VA stated in 2016, "VA experts agree that there is no science to support a specific minimum exposure level for any of the conditions." VA notes in multiple instances that the 30-day requirement is to keep consistency with the requirement for health care but does not assert that there is a scientific basis or legal requirement for the 30-day period.

The regulation added only eight diseases for presumptive service connection and not all fifteen. To confound the matter, the regulation does not require any future studies on the water contamination to consider any additional disease. We urge Congress to enact legislation to remove the 30-day requirement, add all 15 conditions to the presumptive list and establish future studies and reports on diseases potentially related to these exposures.

DAV acknowledges this critical point of toxic exposures and presumptive processes as we cannot afford further delays for the men and women subjected to toxins and environmental hazards. Our veterans and their families are asked to pay the high and horrific human costs of toxic exposures.

REFORMS TO THE PRESUMPTIVE PROCESS

As we have outlined, there are several major concerns over critical exposure and presumptive issues and the inconsistencies that lead to delayed VA actions, which negatively impacts veterans in trying to establish entitlement to their earned benefits including VA health care. Below are DAV's recommendations for reforming the current

presumptive processes, which could be included into one new consistent streamlined framework.

1. **Establish Access to VA Health Care**

   Establishing a service-connected disability is often the gateway for veterans to access VA health care and benefits. However, the lack of access to VA health care for those exposed to toxins including burn pits, PFAS contaminated water and the hazards at K2, who have not yet established a service-connected disability, is a major concern.

   DAV supports amendment to title 38, United States Code, Section 1710 that would include VA health care for toxic exposures, to include burn pits, Ft. McClellan exposures, PFAS contaminated water and K2 veterans.

2. **Establish Concession of Exposure**

   When veterans have been exposed to toxins and current science and medical evidence fails to provide diseases or illnesses, they cannot use the presumptive process to establish service connection for their illnesses. So prior to the establishment of a presumptive process or disease list, the concession of exposure can provide an avenue to establish service connection for access to VA benefits and VA health care.

   A concession of exposure would still require a veteran to provide a diagnosis of a current condition; however, by conceding veterans who served in areas with known toxins, veterans would not have to provide personal evidence of exposure. This will still require veterans to have a medical opinion linking the condition to the exposure. By conceding their exposure to the known toxins, a physician will now have a better ability to provide a medical opinion as the toxins of exposure are known.

   We are urging Congress to establish the concession of exposure for burn pits and it can be applied to all current and future toxic exposures and not require veterans to wait for the scientific community or the VA.

3. **Requiring VA to Apply the Court's Holdings in *Combee* Whenever Applicable**

   Currently when the VA adjudicates a claim that associates a disease to a toxic exposure, but the disease is not one of the recognized presumptive diseases, the claim is usually denied. One of the most common reasons for this denial is that the disease is not listed as a presumptive. However, there is a means for this type of claim to be established based on direct service connection, as determined by the U.S. Court of Federal Appeals. In their decision of *Combee v. Brown*, 34 F.3d 1039, 1042 (Fed. Cir.

1994); they held that notwithstanding the presumption provisions, a claimant is not precluded from establishing service connection with proof of direct causation.

While this precedent has existed since 1994, most VA regional offices fail to apply this legal standard. Additionally, some people in VBA (who have appeared before Congress on behalf of VBA) fail to acknowledge or understand *Combee* when discussing the presumptive process. Many claims based on a toxic exposure for a disease not recognized as a presumptive can be resolved quickly based on *Combee* and would not add to the backlog of pending appeals.

4. **Statutorily Require Future Studies on Toxic Exposures**

Not all of the presumptives have requirements for future studies to be conducted for reviewing and potentially adding new diseases to the established presumptive diseases lists. In multiple reports, the National Academies has stated that additional scientific research and new medical processes continue to change. Therefore, in order to ensure that diseases are properly associated with toxic exposures, any new presumptive process should have a requirement for new reports every two years.

5. **Time Requirement for Action from the Secretary.**

As noted above, the statutory provisions that required the Secretary to respond and take actions on the recommendations from the National Academies have expired. While Congress has the ability to reauthorize the law, or directly add presumptions, no such action has been taken in recent years. This lack of statutory mandate, unfortunately, resulted in no action by VA on the recommendations on three presumptive diseases from 2016 and required Congressional action.

In closing, we are at the critical crossroads of the horrific costs of toxic exposures and a presumptive process that is inconsistent and lacking flexibility moving forward. It is clear that veterans need a way of establishing service connection for diseases related to toxins now and not wait for the scientific community or VA's bureaucratic processes. We recommend reforms to the presumptive process, which should include access to VA health care, a concession of exposure, and time-required actions by the VA.

Mr. Chairman, this concludes my testimony on behalf of DAV. We stand ready to engage with the Committee on toxic exposures and reforming the presumptive processes.

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WOUNDED WARRIOR PROJECT
STATEMENT FOR THE RECORD

Before the

UNITED STATES SENATE
COMMITTEE ON VETERANS' AFFAIRS

With Respect To

"MILITARY TOXIC EXPOSURES: THE HUMAN CONSEQUENCES OF WAR"

March 10, 2021

Chairman Tester, Ranking Member Moran, and distinguished members of the Committee, thank you for the opportunity to submit the following testimony regarding Wounded Warrior Project's (WWP) efforts to assist veterans who were exposed to toxic substances during military service. Like you, WWP has identified this urgent issue as a top priority, and we are grateful to the Committee for holding today's hearing.

Wounded Warrior Project's mission is to connect, serve, and empower our nation's post-9/11 wounded, ill, and injured veterans, Service members, and their families and caregivers. We are meeting our mission through life-changing programming, public policy advocacy, and partnership with like-minded organizations. Since our founding in 2003, WWP has grown from a small, volunteer-led program to an organization with over 700 employees across the country and overseas. Our programs cover a range of services, including benefits counseling, mental health treatment, physical health and wellness activities, job placement assistance, and social engagement opportunities. These programs, services, and connection points contribute to our organizational impact and inform our testimony.

Just as our nation has a responsibility to provide health care and benefits to veterans who suffer physical and mental injuries in service, we must also meet the needs of those who suffer from illnesses associated with exposure to toxic substances, both on the battlefield and in peacetime. For nearly 20 years, a significant number of post-9/11 veterans have been exposed to contaminants such as burn pits, toxic fragments, radiation, and other hazardous materials found on deployments to countries like Iraq, Afghanistan, Uzbekistan, and elsewhere. Now, far too many of them are experiencing severe, rare, and early-onset conditions, which we strongly suspect are correlated to their exposures. WWP is committed to addressing their toxic wounds with the same urgency which we address the physical and invisible wounds of war.

Our testimony today will focus on the experiences of warriors who were exposed to toxic substances while in service. This includes descriptions of the unique challenges they face when

trying to access health care and benefits from the Department of Veterans Affairs (VA), while also highlighting how resilient warriors and family member are under trying circumstances. By telling their stories, we hope to illustrate the human consequences of toxic exposures on the warriors we serve.

WWP's views on the impact of toxic exposures on our alumni are also greatly informed by the results of our 2020 Annual Warrior Survey (AWS), now in its eleventh iteration, which is the largest survey of the post-9/11 veteran population with over 28,000 respondents[1].

2020 AWS Data on Toxic Exposure

Results from WWP's 2020 Annual Warrior Survey confirm that those exposed to toxic substances are more likely to struggle with their health. We found that a majority (70.6%) of warriors reported that they were "definitely" exposed to toxic substances or hazardous chemicals during their service, and another 18.1% reported they were "probably" exposed. Warriors who reported exposures were more likely to indicate poor health. Those who answered, "definitely yes" or "probably yes" to whether they were exposed were more likely to rate their health as poor or fair (49.6%) compared to those who indicated "probably no" or "definitely no" (38.8%). Alarmingly, only 16.1% of those "definitely" or "probably" exposed said they had received treatment at VA for their exposure, while another 11.1% reported that they tried to receive treatment but were unsuccessful.

Additional questions were added to our 2020 survey to better understand what toxic substances warriors were exposed to and what conditions they are experiencing as a result. These questions were only asked of warriors who responded that they were "definitely" or "probably" exposed during service. The largest sources of exposure were burn pits (85.7%), sand, dust, and particles (75.5%), occupational hazards such as solvents and asbestos (43.7%), pesticides (30.3%), and depleted uranium (20.3%). The most common symptoms they reported as a result of their exposures included muscle and joint pain (87.5%), sleep disturbances (85.6%), neurological problems (40.4%), chronic fatigue syndrome (35.8%), gastrointestinal disorders (33.3%), and respiratory disorders (21.6%). An additional 4.1% report some form of cancer. Notably, a mere 2.4% of warriors who report being exposed to toxic substances during military service believe that they suffer no symptoms or illnesses as a result[2].

Warrior Profiles in Toxic Exposure

While our survey data provides an overview of how toxic exposures affect the population we serve, it does not capture the individual challenges that exposed warriors face daily. They struggle with health problems associated with the severe illnesses they have acquired and with policies that often make it difficult for them to access the health care and benefits they desperately need. Their stories have been shared with us by our WWP teammates, who tirelessly advocate on their behalf. We share them in this statement with the goal of putting a face on the human consequences of military toxic exposures.

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[1] The 2020 *Annual Warrior Survey* is available for download and review at https://www.woundedwarriorproject.org/mission/annual-warrior-survey.

[2] For a closer review of the variety of exposures and ailments considered in the 2020 *Annual Warrior Survey*, please see Figures 1-2.

The Struggle to Obtain Benefits

One of the most essential programs we offer is our Benefits Service, which assists warriors and their family members in filing claims for VA benefits, completely free of charge. This is accomplished through our network of 54 accredited service officers operating out of 23 offices from coast to coast. In 2020 alone, they assisted warriors in filing service connection claims for over 33,000 conditions, with an average grant rate of over 90 percent, resulting in a total of over $141 million awarded in disability compensation. Due to their superior training and expertise, WWP service officers ensure that warriors are able to access all the benefits they have earned through their service.

Claims related to toxic exposures, however, often present unique challenges for veterans and service officers alike. Traditionally, VA disability claims are granted by establishing a service-connected disability with a medical nexus linking an in-service event with a veteran's current diagnosis. In the case of toxic exposure-related claims, this is often difficult to achieve due to inconsistent documentation of exposure and long latency periods in which the onset of diseases may not occur until several years after discharge. In response to these hurdles, WWP service officers have begun employing unorthodox methods to gather evidence, such as obtaining the information in the Individual Longitudinal Exposure Record (ILER) and medical opinions from the VA War Related Illness and Injury Center (WRIISC).

The ILER is a web-based application developed between the Department of Defense (DoD) and VA that can assist in determining the linkage between individuals and possible military toxic exposures. ILER can research and cross-reference multiple DoD toxic exposure databases to develop a Service member's exposure history. Previously available only to DoD and VA clinicians and researchers, veterans will soon have access to their own ILER records through a web-based portal, without the need to file a Freedom of Information Act request, thanks to Chairman Tester's amendment to the *FY21 National Defense Authorization Act* (P.L. 116-283 § 9105). WRIISC is a VA post-deployment health resource that provides environmental exposure assessments for veterans that have difficult to diagnose symptoms related to deployment, as well as conducting education and research. Our service officers have seen some success leveraging ILER reports and WRIISC opinions when working on toxic exposure-related claims.

Such was the case with a warrior who we will call "Steve." Although he is a post-9/11 veteran, most of his service took place prior to 9/11 in the U.S. Navy. During that time, he served on a foreign deployment to the Red Sea, as well as at least two domestic duty stations where he reports he was exposed to various toxic substances. After completing his service in 2003, he was shocked to be diagnosed in 2016 with neuroendocrine tumor cancer (NET) that was confirmed stage 4 in March of that year. NET is a rare form of cancer that can affect any part of the body, and in Steve's case, resulted in malignant tumors in and around his adrenal glands. In 2019 he filed a claim for VA disability compensation, asserting that his cancer was caused by military toxic exposures. VA promptly denied the claim without seeking a medical opinion because he did not have a diagnosis of NET in service.

Steve appealed the decision and at this point began working with a WWP service officer who was fortunate enough to obtain his ILER report, confirming exposure to various toxic chemicals to include Benzene, Ethylbenzene, M-Xylene, Naphthalene, O-Xylene, P-Xylene, Toluene, Vanadium, Iron, J-5 Jet Fuel, and J-8 Jet Fuel. We were also able to confirm that the domestic duty stations where he served were listed as Superfund sites by the Environmental Protection Agency. With this information in hand, Steve's WWP service officer requested a WRIISC opinion as to whether his cancer was as least as likely as not caused by his military toxic exposures. Remarkably, WRIISC was willing to assist with this opinion and provided a positive nexus for his case. As a result, WWP anticipates a positive outcome for Steve due to the now-overwhelming evidence that supports his claim. However, without the ILER report or WRIISC opinion, we fear the chance of success would have been little-to-none.

Further examples of these issues can be found in the case of a warrior who we will call "Jeff." Serving in the U.S. Army and National Guard for more than 20 years, Jeff deployed to Fallujah, Iraq in 2004. As an Army Sapper disarming improvised explosive devices, Jeff's job involved countless hazardous missions. He told us of nights he spent finding it difficult to breathe while overseas and how he always seemed to be covered with dust that would never stop collecting on his person. When Jeff left the Army 10 years ago, he did not know that a rare and aggressive leukemia that most commonly occurs in young children and carries a high mortality rate was taking root inside his body.

When our WWP service officer first met Jeff in 2016, he was a physically fit 49-year-old man who liked to run and did not smoke or drink. Two years later, his cancer led to the annihilation of his immune system. His recent urinalysis showed levels of heavy metals that exceeded three times the upper expected limit of what would be considered normal. Yet, despite the fact that he has produced every piece of evidence asked of him, we have been unsuccessful in obtaining a medical opinion supporting the causality between his toxic exposure and his leukemia. So far, Jeff has had four VA compensation and pension examiners weigh in on this issue. While one provider asserted that a relationship exists, the other three disagreed. They used the same reason we commonly see in unfavorable VA medical opinions, "A strong association is not proof of causation." VA did not concede toxic exposure; thus, VA examiners will not speculate on the connection of leukemia to service. WWP has filed an appeal on Jeff's behalf, but this takes time he may not have.

Lifelong Support

By no means does WWP's advocacy for warriors end with a VA disability decision. Through a dozen different WWP programs and services, we help meet the needs of wounded, ill, and injured warriors at every phase of their lives with the support that is appropriate to their unique situations. Two programs that are critical to this approach are our Independence (IP) and Complex Case Coordination (C3) programs. Our IP team provides the most severely wounded, ill, and injured warriors with the resources they need to thrive in the most independent and meaningful way possible. Our C3 team provides rapid, coordinated responses for warriors dealing with complex, urgent issues that require immediate intervention. Those two teams shared the following stories with us.

A warrior who we will call "Sarah" served as a logistics officer and quartermaster in the Army National Guard. While deployed to Iraq, she suffered exposure to neurotoxins emitted by open-air burn pits. In 2006 after returning home, she was diagnosed with multiple sclerosis, which she understandably believes was caused by burn pit exposure. While this is a serious and debilitating illness, she was fortunate that it was diagnosed while she was still in service. Consequently, her disability is recognized by VA as service-connected and she was retired from the National Guard in 2008. Since then, our IP team has been working with her to help maximize her independence.

Today, Sarah uses a power chair to get around and has limited use of her hands. She is able to live independently but requires a home health aide (HHA) to maintain her home. When her HHA recently quit, her IP case manager began working with her to secure another HHA agency and speaks with her regularly to help connect her with community resources. Our IP program was also able to fund smart technology in her home to include smart lights, door locks, a thermostat, and a virtual voice assistant to support her independence. Sarah is highly engaged with WWP virtual alumni events and looks forward to attending face-to-face adaptive sports and physical health and wellness events once they are available again in her area.

Another story is that of a mother who we will call "Lynda," a widow of a retired veteran who also had two sons, one of which had recently separated from military service who we will call "John." John, a post-9/11 veteran himself, developed an aggressive form of leukemia and was terminally ill by the age of 24. He was in hospice in Texas but without VA compensation and the family having a limited income, Lynda was unable to travel with her other son to Texas (TX) from Maine (ME) to spend the last days of John's life with him. As the widow of a retiree, Lynda tried to utilize the military Space A program but was not eligible. Without knowing where to turn, an Air Force official approached WWP to see how we could help.

After coordinating with Rep. Jared Golden's district staff, we were able to leverage both WWP's C3 team as well as utilize our Emergency Financial Assistance program to assist. The C3 team connected with Lynda to provide aid and comfort. They secured flights for Lynda and John's brother so that they could fly from ME to TX. While in TX, we arranged hotel accommodations for the family and ensured they were able to stay until the passing of John. It was our honor and privilege to assist in providing this last gathering between mother and dying son at no cost to them. While it is unclear why such a young veteran would have such an aggressive form of cancer, it illustrates the trend of young veterans developing rare illnesses after separation from service.

Finally, we would like to tell the story of a warrior named Scott Evans. He asked that we use his real name as he feels it will make his story even more impactful. Scott deployed twice to Afghanistan as a Marine Corps combat engineer and as a dog handler. He served valiantly in the battle of Marjah. Unfortunately, he also suffered exposure to open-air burn pits during his deployments. After being honorably discharged from the Marine Corps in 2012, Scott immediately began working a full-time civilian job. Like many hard-charging veterans, since he felt that he suffered no significant disabilities from his service, he never enrolled in VA medical care.

Sadly, in the Spring of 2020, at the age of 32, Scott started experiencing severe abdominal pain and rapid weight loss. At that point, when he attempted to enroll for care at his local VA Medical Center (VAMC), he learned that he was ineligible since he never filed a disability claim and he was beyond the 5-year enhanced eligibility period for combat veterans. Furthermore, his income as a restaurant systems manager precluded him from enrollment based on financial need.

In July of 2020, a friend who had served with Scott reached out to WWP to see if we could help. By this time, Scott had incurred about $20,000 in medical bills seeking a diagnosis and treatment for his condition. Immediately, our C3 teammate met with Scott and his wife to assess the situation and determine what resources would be needed. It was obvious that Scott was critically ill.

Our C3 teammate convinced Scott to return with him to the VAMC. Upon arrival, the emergency room doctors immediately recognized the seriousness of the situation but needed Scott to visit the eligibility office before they could provide further care. Eligibility told him once again that he was ineligible to receive care until he was service connected. After Scott and his wife left the room, our C3 teammate returned to the clerk and told him that Scott was an uninsured, terminal cancer patient with multiple combat tours and an honorable discharge. He reiterated that WWP's Benefits Team was filing expedited claims on his behalf for several service-connected conditions but that he needed life-preserving treatment now. The clerk relented after looking further at Scott's combat service record, and he was enrolled at VA.

Since his enrollment, Scott has received compassionate life-prolonging care at the VAMC for his illness, eventually diagnosed as terminal pancreatic cancer. Even though it hurts to walk, when Scott is receiving treatment, he travels around the hospital visiting with veterans in other wards and has quickly become a favorite patient of the doctors and nurses. Scott has since been granted service connection for disabilities unrelated to toxic exposure, but WWP is grateful that our C3 teammate was able to obtain care for him as early as possible with his unwavering advocacy. Sadly, a veteran without such an advocate may have been turned away.

Each of these warriors, although dealing with tremendous adversity, is also inspiring in their perseverance. They hope that by sharing their stories, we can provide a snapshot of the challenges facing veterans with toxic exposure-related illnesses and demonstrate the urgency of this issue.

Policy Recommendations

Motivated by the stories of warriors like these, our data, and the shared priorities of other advocates, WWP spearheaded the formation of the Toxic Exposure in the American Military (TEAM) Coalition. Currently comprised of over 30 military and veteran service organizations and experts, the TEAM Coalition is collectively dedicated to raising awareness, promoting research, and advocating for legislation to address the impact of toxic exposures on all those who have been made ill as the result of their military service, now and in the future.

After nearly two years of collaboration and consensus-building, the TEAM Coalition successfully advocated for the introduction of the *TEAM Act*. This comprehensive bill would provide VA health care eligibility for all veterans exposed to toxic substances and create a framework for establishing presumptive disabilities for all toxic exposures irrespective of era or location of service, among other provisions. First introduced in July 2020 as S. 4393 (116th Congress), the *TEAM Act* was advanced unanimously by the Senate Committee on Veterans' Affairs in December 2020 after undergoing a bipartisan amendment process which we believe made the legislation stronger. WWP and the TEAM Coalition fully supported the amended version of S. 4393, and we look forward to its reintroduction and passage this year.

Prioritize the Extension of Health Care

Traditionally, eligibility for VA health care is established when a veteran is granted one or more service-connected disabilities. For reasons already discussed, this is often an exceedingly difficult task when dealing with toxic-exposure related conditions. According to VA data, from June 2007 to July 2020, only 2,828 of the 12,582 (22%) veterans who claimed conditions related to burn pit exposure were granted service connection [3]. One critical consequence of these decisions is delayed access to VA care. WWP strongly believes that VA health care enrollment eligibility should be granted to any veteran who suffered toxic exposures while in service, regardless of their service-connected disability claim status.

Our call for expedited health care access is not unprecedented. Legislation enacted over the course of several decades has provided health care eligibility to previous generations of veterans with toxic exposure concerns. Veterans who served in the Republic of Vietnam between January 9, 1962, and May 7, 1975, and the Persian Gulf War between August 2, 1990, and November 11, 1998, are eligible for priority group 6 VA health care enrollment without the need to establish a service-connected disability.[4] Currently, veterans who served in combat and were discharged after January 28, 2003, are eligible for enrollment on a similar basis, but only for a period of five years. As in Scott's case, we know that this access does not go far enough. We can achieve parity for post-9/11veterans who served in areas of known exposure by granting them permanent Priority Group 6 enrollment eligibility. We believe this is critically important, as it would prevent veterans like Scott who are seriously ill from having to wait until their claims are decided to access the care they need – a process that can take months or even years if the claim goes to appeal. Furthermore, we believe that veterans who were exposed to toxic substances but may not be ill should have access to regular preventative care so that any illnesses that may arise can be diagnosed and treated early before they become serious or even life-threatening.

For these reasons, access to care is WWP's top priority regarding toxic exposure legislation. To achieve this, the *TEAM Act*, as amended, would expand priority group 6 health care enrollment eligibility to any veteran who earned certain medals associated with post-9/11 deployments or is eligible for inclusion in the Airborne Hazards and Open Burn Pit Registry.

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[3] *Toxic Exposures: Examining Airborne Hazards in the Southwest Asia Theater of Military Operations: Hearing Before the Subcomm. on Disability Assistance and Memorial Affairs of the H. Comm. on Vet. Affairs*, 116th Cong., (2020) (testimony of Laurine Carson), *available at* https://docs.house.gov/meetings/VR/VR09/20200923/111024/HHRG-116-VR09-Wstate-CarsonL-20200923.pdf.

[4] *VA Priority Groups, Department of Veterans Affairs, available at https://www.va.gov/health-care/eligibility/priority-groups/*

This bill would also grant eligibility to any veteran who DoD identifies as having been possibly exposed to a toxic substance inside or outside the United States (and establish a mechanism that would allow veterans to self-identify as having been exposed). WWP strongly supports these provisions and believes their enactment would provide lifesaving treatment and preventative care to all those who were exposed to toxic substances, now and in the future.

Adopt a Framework to Establish Presumptive Disabilities for All Toxic Exposures

Recognizing the challenges associated with establishing direct service connection for toxic exposure-related conditions, Congress has historically created mechanisms that require VA to make determinations on whether to establish presumptive service connection when scientific data show a link between specific exposures and associated illnesses, as it did for Vietnam veterans with the *Agent Orange Act of 1991* (P.L. 102-4). However, no law currently exists to require VA determinations on illnesses associated with all toxic exposures, regardless of location or period of service.

The *TEAM Act*, as amended, would require a framework for establishing presumptive conditions for veterans exposed to toxic substances now and in the future. This would include the establishment of an independent Toxic Exposure Review Commission comprised of scientists, health care professionals, and veteran service organizations (VSOs). This commission would collect information and hold public meetings to identify all possible military toxic exposures and make recommendations to VA on whether scientific reviews are warranted. VA would concurrently enter into an agreement with the National Academies of Science, Engineering, and Medicine (NASEM) to conduct scientific reviews regarding associations between diseases and military toxic exposures based on the recommendations of the commission. Upon receiving a report from NASEM, VA would be required to respond within an established timeframe and the Secretary would be authorized to grant presumptive service connection for diseases by reason of having a positive association with exposure to a toxic substance. If VA declines to do so, they must publish their scientific reasoning in the Federal Register for public comment.

Recognizing that scientific research takes time and far too many veterans are already suffering from toxic exposure-related illnesses, we urge the establishment of this framework without delay. While WWP has and will continue to support legislation that creates presumptive conditions by statute in cases where VA has failed to act, we believe that all veterans who have been exposed to toxic substances deserve a system that requires VA to respond to scientific data in a timely, transparent manner.

Improve Direct Service Connection for Toxic Exposures

As Congress and the scientific community continue to consider a way forward for presumptive service connection, WWP believes direct service connection for toxic exposure-related illnesses can also be improved in a number of ways. One of the hurdles that many ill veterans find impossible to overcome is proving exposure to a specific toxic substance while in service. Given that this information often does not exist, we believe it is unreasonable that veterans like Jeff should have their claims denied on this basis. The *Veterans Burn Pits*

Exposure Recognition Act, recently reintroduced as S. 437, would solve this problem by conceding exposure to burn pits and other toxic substances currently accepted by the VA adjudication manual for any veteran who served in locations recognized by the VA Airborne Hazards and Open Burn Pit Registry. It would also require VA to request a medical opinion on the link between illness and exposure when the evidence alone is insufficient to grant the claim. WWP supports this legislation and looks forward to working with the Committee and our VSO partners to secure its passage.

Another way we believe claims for direct service connection can be improved is by clarifying the use of ILER. We have identified that one challenge veterans face when filing claims for toxic exposure-related illnesses is in the development of evidence during the adjudication process. Although ILER exists as a tool to assist with a veteran's claim, and veterans like Steve have been able to benefit from it in isolated cases, VA is not required to use it. For this reason, we urge VA to consider adding development provisions and information on the ILER report to its Adjudication Procedures Manual. We note, however, that there are gaps and inconsistencies in ILER data, and a lack of information in ILER should never be used as a reason to deny a veteran's claim.

Finally, we recommend that VA regional offices become familiar with and consider soliciting medical opinions or evidence in support of veterans' claims from the WRIISC. As we saw in Steve's case, the information contained in ILER and medical opinions from WRIISC clinicians can be critical in fully developing a toxic exposure claim. Furthermore, in the rare instances where WRIISC opinions are already included in a veteran's claim, we believe that VA claims adjudicators should be instructed to place a heavy weight on these expert opinions.

Chairman Tester, Ranking Member Moran, and Members of the Committee, this concludes our statement. Once again, WWP would like to thank you for holding this hearing on the human consequences of military toxic exposures. Like you, we consider this issue to be among our highest priorities, and we look forward to working closely with the Committee to confront this urgent issue in the 117th Congress.

Figure 1: Sources of Environmental Hazards Exposure Among Warriors Indicating Toxic Exposure

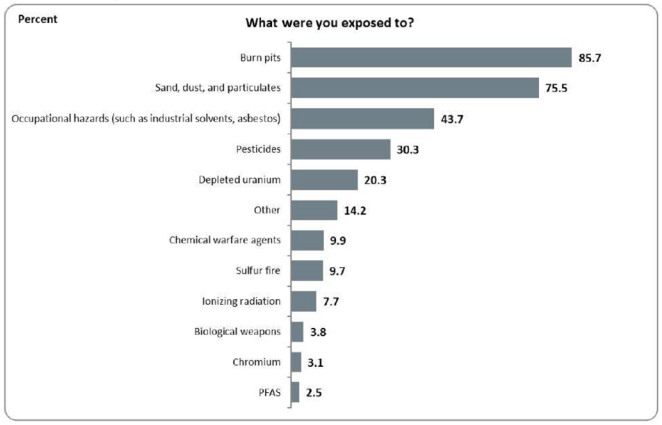
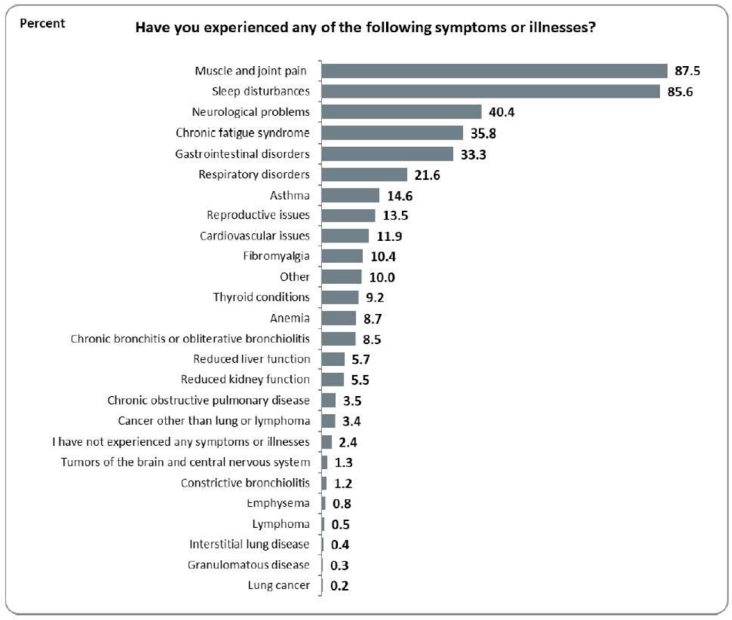


Figure 2: Symptoms and Illnesses Experienced from Environmental Hazards Exposure Among Warriors Indicating Toxic Exposure



STATEMENT FOR THE RECORD

TRAGEDY ASSISTANCE PROGRAM FOR SURVIVORS (TAPS)

BEFORE THE

COMMITTEE ON VETERANS' AFFAIRS

UNITED STATES SENATE

"MILITARY TOXIC EXPOSURES: THE HUMAN CONSEQUENCES OF WAR"

MARCH 10, 2021

The Tragedy Assistance Program for Survivors (TAPS) is the leading national nonprofit organization providing comfort, care and resources to all those grieving the death of a military loved one. TAPS provides comfort and hope through a national peer support network and connection to grief resources, at no cost to surviving families and loved ones.

TAPS provides programs to survivors across the nation and worldwide. Since 1994 the National Military Survivor Seminar and Good Grief Camp has been held annually in Washington, D.C. over Memorial Day weekend. TAPS also conducts regional survivor seminars for adults and youth programs at locations across the country, as well as adult retreats around the world. TAPS connects those in need with counseling in their community and helps navigate benefits and resources.

TAPS provides loving support and resources 24/7 through its National Military Survivor Helpline.

TAPS was founded in 1994 by Bonnie Carroll following the death of her husband in a military plane crash in Alaska in 1992. Since then, TAPS has offered care and support to more than 100,000 bereaved surviving family members.

Chairman Tester, Ranking Member Moran, and distinguished members of the Senate Committee on Veterans' Affairs, the Tragedy Assistance Program for Survivors (TAPS) is grateful for the opportunity to provide a statement for the record on issues and concerns of importance to the families we serve, the families of the fallen.

The mission of TAPS is to offer comfort and support for surviving families of military loss regardless of the location or manner of their death. Part of that commitment includes advocating for improvements in programs and services provided by the Federal government through the Department of Defense (DoD), the Department of Veterans Affairs (VA), Department of Education (DoED), Department of Labor (DOL), Department of Health and Human Services (HHS), as well as State and local governments.

TAPS and the VA have enjoyed a long-standing collaborative working relationship. In 2019, TAPS and the VA entered into a new and expanded Memorandum of Agreement that formalized their partnership intended to provide extraordinary services through closer collaboration.

Under this agreement, TAPS continues to work with surviving families to identify resources available to them within the VA and in the private sector. TAPS also collaborates with the VA in the areas of education, burial, benefits and entitlements, grief counseling, survivor assistance, and other areas of interest.

TAPS appreciates the opportunities provided by the quarterly Department of Veterans Affairs (VA) and Department of Defense (DoD) Survivors Forum, which works as a clearinghouse for information on government and private sector programs and policies affecting surviving families. TAPS partners with the VA/DoD Survivors Forum to share information with our colleagues on the extent to which TAPS programs are supporting all military loved ones during the COVID-19 global crisis.

TAPS President and Founder, Bonnie Carroll, serves on the Department of Veterans Affairs Federal Advisory Committee on *Veterans' Families, Caregivers, and Survivors.* The Committee advises the Secretary of the VA, through the Chief Veterans Experience Officer, on matters related to Veterans' families, caregivers, and survivors across all generations, relationships, and Veteran status. Ms. Carroll also serves as a PREVENTS Ambassador for the VA's initiative on preventing suicide.

UNDERSTANDING ILLNESSES THAT MAY RESULT FROM TOXIC EXPOSURE

According to the Department of Veterans Affairs, a significant number of veterans who served after 9/11 were exposed to more than a dozen different wide-ranging environmental and chemical hazards, most of which cause serious health risks. Whether from open burn pits, depleted uranium, toxic fragments, or particulate matter, service members and veterans are getting sick and prematurely dying from uncommon illnesses and diseases that are tied to exposures to toxins.

The Tragedy Assistance Program for Survivors' (TAPS) interest in understanding illnesses that may result from exposures to toxins stems from our desire to ensure surviving families have access to all available survivor benefits earned through the service of their loved one. The information that can be gathered from our survivor histories is also invaluable in establishing patterns and baselines that can be applied to the veteran and military community, save lives, and prevent this now and in the future.

Over the past five years, the number of survivors of a military death due to illness seeking TAPS services increased by 143 percent. As of January 1, 2021, more than thirty percent of all military survivors connecting with TAPS have experienced a loss due to illness. Military deaths due to illnesses (30%) and suicide (31%) are the leading causes of death among new military survivors connecting with TAPS and far surpasses all other circumstances of death, including hostile action.

TAPS re-launched a national Military Survivor Illness Loss Survey, to learn more about the issues faced by military members who have passed away post-deployment. Among the 722 respondents who accessed the survey, the survey found that 66% of survivors reported their service members served post 9/11. The rates of cancer among pre- and post-9/11 service members are similar at 58% and 57% respectively. Survivors reported that their loved one was misdiagnosed in over 40% of post-9/11 cases. Among age groups, those ages 31 - 40 reported the highest misdiagnosis rate. A majority of post-9/11 service members reported requiring a caregiver. While 67% of all survivor respondents reported their service member required a caregiver, 60% of post-9/11 service members reported that they required a caregiver. Results included only demonstrate initial findings. To strengthen the validity of these findings, TAPS plans to collect and analyze additional survey data to provide further insight into the experiences of service members and veterans, and illustrate any trends that may warrant continued research.

Together with other partners in the military and veteran community, TAPS is working to advocate for veterans exposed to toxins, their families, caregivers, and survivors. Through these partnerships, we have made great strides over the past three years to create a growing awareness of the issue of toxic exposure by enlisting support from other organizations, such as members of The Military Coalition (TMC), comprised of 35 organizations representing more than 5.5 million members of the uniformed services - active, reserve, retired, survivors, veterans - and their families.

TAPS is also a founding member of the Toxic Exposure in the American Military (TEAM) coalition, a group of 30 military and veteran service organizations and experts. The TEAM coalition is collectively gathering data, raising awareness, and promoting research. The TEAM coalition was instrumental in drafting landmark legislation, the *Toxic Exposure in the American Military Act of 2020* (TEAM Act), introduced during the 116th Congress, that fundamentally reforms and improves how veterans exposed to toxic substances receive health care from the Department of Veterans Affairs. The TEAM Act will be reintroduced in the 117th Congress.

ILLNESS LOSS SURVIVOR TESTIMONIALS

Death by illness is one of the leading causes of death among military survivors. Since 2008, TAPS has been supporting 13,870 survivors whose military loved ones died due to an illness. In 2020 alone, 2,283 new survivors of a death by illness reached out to TAPS for support and services. Sadly, we project this number to increase by more than 2,300 each year based on current trends.

While we know there's a significant number of veterans who die of common illnesses, we have become deeply concerned that like the Vietnam era, post 9/11 veterans have been exposed to toxins that are known to cause terminal illnesses. TAPS is working to gather survivor stories and aggregate data to better understand the scope and types of illness loss. Here are a few of the many stories we have collected from our surviving families:

Coleen Bowman, Widow of SGM Robert Bowman

"Rob was the picture of health before he deployed, he was an Airborne Ranger. When he returned from his second deployment from Iraq, he was sick. In June 2011, Rob was diagnosed with an extremely rare cancer Cholangiocarcinoma (bile duct cancer). During deployments, Rob was in close proximity to an open-air burn pit that burned around the clock. His vehicle was struck at least ten times by IEDs, stirring up particulate matter.

Had we known he had been exposed and to what toxins, we could've shared the information with doctors, and it wouldn't have taken six months of misdiagnoses before we learned he had stage 4 inoperable cancer. Had we known earlier he might still be alive today. For 19 months my daughters and I cared for him, and on January 13, 2013 Rob passed away at the age of 44. Several of the men that Rob served with have many different illnesses, to include cancer, and several have passed away since at very young ages."

Tim Merkh, Father of Corpsman Richard Merkh

"My son Richard Merkh was a Corpsman in the Navy. He had served over 15 years and died from cancer on October 3, 2018. Richard served several tours with the Marines during the war. His lodging facilities were on only trash or dump sites. It is my belief that Richard contracted stage 4 cancer from his exposure during the war. Cancer does NOT run in my DNA, nor my wife's. So where did he contract the cancer... his exposure. Unfortunately, he was diagnosed after his entire liver and colon was infected with cancer.

I am a retired USAF veteran. I know what we put our troops through. Some things must change. Richard was survived by his wife of twelve years and a beautiful 4-year-old daughter, my precious granddaughter. We can't change Richard's outcome, but we must ensure we treat and support our troops better."

Nicoele, Drew, and Maggie Arseneau, Widow and Children of Specialist Andrew Arseneau- US Army

"My children Drew and Maggie lost their father, and I lost my husband, Andy, six years ago on September 12, 2014 to lung and heart failures due to toxic exposures during his service in Iraq, Saudi Arabia, and Kuwait during Desert Storm. He was only 46.

We first filed his health claims with the VA in 2010. They were denied and we were in the very lengthy appeals process when he passed away in 2014. He was approved 100%, permanent and total for his PTSD, but his toxic exposure claim was denied. He could no longer work due to his illness and I was his full-time caregiver for four years.

I filed for DIC benefits for the children and myself immediately after his death. I'm still fighting today for approval after paperwork was lost by the VA forcing me to lose possible back pay and start the process from the beginning after ten years. He has been gone for six years and this process has taken a toll on our family."

June Heston, Widow of BG Michael Heston

"Mike was active duty in the Vermont National Guard. He deployed to Afghanistan three times. First in 2003 for 7 months, then 2006-2008 for 15 months, and last 2011-2012 for one year. In April of 2016, Mike had gone into the doctor not feeling well. For 10 months doctors couldn't figure out what was wrong with him. Finally, in January of 2017, Mike was diagnosed with a very rare form of pancreatic cancer, stage 4. Mike passed away shortly after that on November 14, 2018."

Laura Forshey, Widow of Sgt Curtis Forshey

"Three months into his deployment, he began to experience bloody noses that would go on for hours at a time. He went to the doctor there on the FOB where they ran bloodwork. The results showed his white blood count was way off. They flew him to Landstuhl, Germany.

His wife, Laura, and 3-month-old son, Ben, along with Curt's parents flew to be with him in Germany. While they were in flight, Curt passed away. His cause of death was a brain aneurysm, caused from the cancer they discovered, Acute Promyelocytic Leukemia.

Curt was 22 years old. He died on March 27, 2007. With proper diagnosis and treatment it is curable in 80-90% of patients."

Rev. Jennifer Moser, Widow of LTC Gregory Moser

"My husband LTC Greg Moser was an IL National Guard Chaplain, deployed to camp Phoenix. He left healthy in 2008. He returned in 2009 with a wracking cough that never fully went away. He died on December 24, 2016 from complications of the stage IV lung cancer he'd been diagnosed with six months earlier.

Being a Chaplain and parish Pastor, he had no history of Toxic Exposures from any other source (he didn't work in heavy industry or some such in his civilian life). And there was no history of cancer in his family whatsoever. Heart disease and diabetes, yes. Cancer, no!

As a result of his death being ruled active duty, honorable but not in the line of duty, I do not qualify to receive his pension, and Greg's four children do not qualify for tuition help, such as the Fry Scholarship. Moreover, the "not in the line of duty" ruling is an emotional slap in the face to our National Guard soldiers who fought a ten-year war with multiple deployments. Often taking pay cuts to serve and dealing with trauma to families of multiple and sudden deployments, only to have DoD tell us those deaths aren't service-connected."

Kris Marbutt, Widow of Sgt John Marbutt

"He worked very closely to the burn pits. In 2010 he was diagnosed with a brain tumor and told it was benign. He was initially denied a CT scan. He was diagnosed with a second 'huge tumor' glioblastoma. He died on October 21, 2016. He was 34 years old."

Amber Bunch, Widow of LCPL Mark Bunch

"After returning from his second deployment he was different mentally and physically. From the outside looking in one could see the effects of war followed him home, facing PTSD and Survivors Guilt.

On the other hand, the more noticeable conditions began to appear including insomnia paired with night terrors, breathing issues, constant coughing, stomach issues that could not be resolved, migraines that lasted for days, sudden mood changes, lower back pain, sleep apnea, memory loss, and the list could go on. I fought and fought for us, for our family.

On February 26, 2014, my battle for my husband Mark Bunch Jr's legacy began upon his passing. I never imagined six years later I would still be fighting for benefits."

Louise Carroll, Widow of Vietnam Veteran Larry Carroll

"My husband Larry was in the Army and Navy for 27 years. He was in Vietnam where he contracted Agent Orange. From 2004 to 2017, I watched my husband die slowly with new comorbidities that were from cancer to COPD plus all kinds of lipomas and heart problems. His percentage of disability was 265 percent. He was on morphine for pain.

I touched every part of his body not knowing the terrible problems to me. For three years now, I have had places come up on my face and body that end up like burns. I have been treated for everything but cannot be given a diagnosis.

I believe, because I was exposed to all of his secretions, that through his blood I contracted Agent Orange. I called the VA for help in testing and they refused, very hurriedly telling me this was impossible. At the time, I had surgery on my knee and hip from lifting him and dressing my own wounds. No way it was sterile. I am retired from the medical field and know I am sick."

Tanja Smith, Military Spouse

"While I haven't lost someone due to this, my husband was deployed several times and spent time at the burn pits, which makes me worry about the future and how the burn pits may cause issues with his health."

EXPOSURE-RELATED ILLNESSES

Exposures to deadly toxins as a result of military service is not a new phenomenon, unfortunately generations of service members have been exposed and many have died as a result. Our country must do more to prevent exposures, properly treat and provide benefits for those who have been exposed. There are more than 2.7 million veterans affected by Agent Orange and over 425,000 veterans affected by Gulf War Syndrome. There are more than 3 million service members and veterans that may have been exposed to toxins while serving after 9/11, including but not limited to service during Operation Enduring Freedom and Operation Iraqi Freedom.

Currently, there are more than 230,000 veterans enrolled in the VA Airborne Hazards and Open Burn Pit Registry – those who deployed to the Southwest Asia theater of operations after August 1990 or served on or after 9/11 and were deployed to a base or station where open burn pits were used. While the federal government has created a self-report registry, they admit it is a flawed and limited system that covers only exposures to burn pits. There has not been enough attention placed on ensuring that ALL those exposed to burn pits have been included and it is widely (and justifiably) criticized as focusing too narrowly on one type of many exposures. Sadly most young veterans who have died as a result of their exposures to toxins never knew to register.

There are millions of service members and veterans who were exposed to burn pits and other toxins while serving, and sadly many will die from exposure-related illnesses. Their loved ones will make up a large portion of the next generation of TAPS survivors.

In 2021, TAPS believes that deaths due to illness will be the leading cause of death among military survivors. It's time to take action and learn more about which toxins are causing rare cancers and other illnesses in our young people. Research must be done in and outside of government. We don't have time on our side, we already know a number of toxins our troops were exposed to are carcinogens. The Department of Defense has the ability to determine who was exposed to what toxins, when they were exposed and can work together with the VA to notify every affected service member and veteran. We must get this

information into the hands of veterans and their medical providers so they can plan for early screening, make connections for accurate diagnosis and effective early treatments and ensure that they are receiving the benefits and services they have earned through their service to our nation.

The Departments of Defense and Veterans Affairs are working to mine data to match exposures to veterans, but they must work harder and faster. The information that should be mined from the Individual Longitudinal Exposure Record (ILER) could be groundbreaking, and TAPS is proud to have strenuously advocated that the final version of the *National Defense Authorization Act (NDAA) for Fiscal Year 2021*, requires the ILER be expanded to allow veterans to access their personal records. We continue to call on Congress to require DoD and VA make this critical information available to veterans' families and survivors.

We know pre- and post-9/11 generation service members were exposed to toxins while serving overseas. The sobering consequence has been thousands of unexplained illnesses, many of them terminal. The loss of a service member or veteran to illness can be especially difficult when the survivor is unable to "prove" a service connection. This results in an absence of death benefits for survivors or acknowledgement of responsibility by the government that the illness and/or death of the loved one was caused by exposure to toxins.

WHAT TAPS IS DOING

We must provide answers to our survivors of military loss. So many are left wondering how their loved one survived deployments and returned home safely, only to succumb to illnesses years after returning home.

Like we did when we saw increasing trends and deaths by suicide, TAPS is developing a program to specifically address the needs of our survivors who grieve the death of their loved one to an illness. Many are left wondering how their physically fit military member could succumb to such an aggressive and rare illness that ended their life.

Through our research, TAPS has learned that many illness loss survivors have been caregivers first. Of the 722 respondents who accessed the Illness Loss Survivor Survey, 60% of post-9/11 service members required a caregiver before their death to perform their activities of daily living, to administer medications and be at the bedside - sometimes for lengthy periods of time.

TAPS recognizes the urgent need to support families who have lost a military loved one after having been caregivers. As a result, TAPS is standing up our "Caregiver to Survivor" program and formalizing existing partnerships with the American Red Cross and other nonprofit organizations to warmly transition caregiver families to surviving families. Our program will provide hope and healing to thousands of veteran and military families who are experiencing the devastating loss of loved ones to illnesses and/or injuries related to their overseas service.

CONCLUSION

TAPS applauds Congress and this committee for conducting oversight of the devastating effects of toxic exposure on our veterans, their caregivers and survivors. We urge Congress to legislate critical funding for toxic exposure research and education; expand healthcare and benefits for veterans, caregivers and survivors; and build a public awareness campaign so we can save lives.

Those who volunteer their lives to protect the freedom of our nation and the families who stand beside them are ready to know America's priority is to protect and provide for all those who are ready to make the ultimate sacrifice.

The Tragedy Assistance Program for Survivors thanks the leadership of the Senate Committee on Veterans' Affairs and it's distinguished members for holding this important hearing on toxic exposure, and providing TAPS the opportunity to submit a statement for the record.

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