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Presumptive Benefits for War Fighters Exposed to Burn Pits and Other Toxins Act of 2021: *Cadit qaestio*

***To the Editor*:**

The 2003 US invasion of Iraq, and resulting conflicts in the Middle East, has led to the longest prolonged military deployment in US history. As of 2020, over 1 million soldiers have served in Iraq and Afghanistan. This 17-year conflict is longer than that of US involvement in World War II and the Vietnam War combined.[1] Characteristic of these operations termed Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), Operation New Dawn (OND) is the frequent reporting of respiratory symptoms among active-duty troops and returning veterans.[2] According to the Department of Veterans Affairs Burn Pits Registry, 26.2% of 150,000 registered military personnel who were deployed to Iraq and Afghanistan self-reported new-onset, deployment-related respiratory symptoms due to poor air quality, and 14.5% of a New York-based cohort reported new-onset asthma symptoms.[2,3]

Novel since 2003 are prolonged deployments entailing 1 year of service, often with multiple year-long deployments. These deployments resulted in prolonged exposure to potential airborne hazards. Plausible airborne hazards on the battlefield to account for new-onset dyspnea include exposure to frequent dust storms, which, reflecting geology of the region, yield a sticky, less than 5 μm-sized sharp particulate exposure.[4] We and others, including Dr. Robert Miller at Vanderbilt, have detected dust particles in lungs of returning troops. These dust particles appear as polarizable crystals.[5] With the National Synchrotron Light Source II at Brookhaven National Laboratory, we have determined that these crystals contain metals such as iron and titanium, bound in specific ratios of seven parts iron to one part titanium, supporting an anthropogenic source.[6] Moreover, our preliminary data of surface grab samples from Camp Victory, Iraq show the presence of polycyclic aromatic hydrocarbons (PAH) when we utilized Rahman Spectroscopy. PAH have also been detected in the lungs of men/women post deployment. We also see PAH in mice who had this dust administered intratracheally. The dust injury in mice is largely reversible histologically and volume loss is partially reversible with a candidate antioxidant compound called Rux.

Most importantly, we can detect black, carbonaceous particles containing PAH in lung biopsies from symptomatic soldiers. Why is this important? The reason is that, for this war, most of trash and refuse elimination occurred via burning in open-air trenches called "Burn Pits" without the use of incinerators. All types of trash were burned, including plastic, metals, and medical waste. Uniformly, trash was ignited using JP-8 jet fuel containing benzene, a known carcinogen.[7] Burning in this fashion generates strikingly greater masses of particles than incineration because burn pits burn at a lower heat than incinerators, thereby generating more particles and products of incomplete combustion.[8] Increased particulate matter air pollution in Balad, Iraq was recorded as high as 1000 $\mu m/m^3$ which exceeds the Environmental Protection Agency (EPA) established limits of 150 for 10-μm-sized particles.[2,9] Particulate matter air pollution is linked to all-cause mortality, cardiovascular disease, stroke, asthma, and chronic obstructive pulmonary disease.[10] For comparison, even indoor wood cookstoves in rural India have led to high rates of cardiovascular and pulmonary disease from exposure to products of incomplete combustion.[11]

Another airborne hazard is exposure to improvised explosive devices (IEDs), including vehicle IEDs. When a roadside phosphate bomb explodes a Humvee vehicle, metal is vaporized and inhaled. Shock waves from the explosion send shear stress to delicate lung alveoli to cause lung injury.[12] The shock waves, which may also induce traumatic brain injury, frequently lead to post-traumatic stress disorder (PTSD), which, in and of itself, is associated with higher rates of asthma. Studies from the Vietnam War among monozygotic twins showed that if one is diagnosed with PTSD, there is a statistically higher rate of asthma in the affected twin.[13] The dilemma with military personnel, who typically have asthma as an exclusion diagnosis for enlistment, who must pass basic training outdoors, and who must be fit for deployment at Fort Hood prior to deployment, is that they usually do not have pre-deployment pulmonary assessments.[2] Unlike the Fire Department of New York which requires annual spirometry and was able to assess respiratory changes after 9/11, soldiers most often do not have a baseline for comparison other than their 2-mile run time.[14] An otherwise healthy young soldier may be 100% or more predicted on spirometry and oxygen consumption from a cardiopulmonary exercise test predeployment. So, reduction to 80% predicted postdeployment is a significant decrease.

Further complicating the diagnostic dilemma is the realization that even video-assisted thoracoscopic surgery, while minimally invasive, is still associated with anesthesia and surgical risk.[15] We have adopted in our practice a holistic approach relating to assessing pre-deployment and post-deployment exercise capacity; conducting spirometry, with impulse oscillometry to assess distal airway narrowing, reversibility, and airway hyperresponsiveness; excluding an atopic diathesis with percutaneous skin prick testing, intradermal testing, exhaled nitric oxide, Immunoglobulin E, and complete blood count with manual differential; assessing for the potential of biological modifier use; and utilizing inspiratory and expiratory CT scan to look for a mosaic pattern. The potential for xenon or polarized helium magnetic resonance imaging to further characterize lung deficits in this population has been recently studied at Duke but is not widely available. Last year, 4Dmedical received Food and Drug Administration approval for software stacking of chest Ct and C arm fluoroscopy images to make color-coded 3D videos with tidal breaths. No patients have utilized this yet. None of these modalities will detect constrictive bronchiolitis, metals, or PAHs

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without tissue. We have recently detected pulmonary ossification in lung biopsies of deployed soldiers, which may largely reflect inhalation of metals due to the proximity of ossification to polarized crystals containing titanium and iron and PAH. Mikala Egeblad at Cold Spring Harbor Laboratory is examining evidence of neutrophil extracellular traps as the etiology of lung fibrosis in mice with intratracheal instillation of Camp Victory dust and in lung tissue of soldiers who were deployed to Camp Victory, Iraq. Since the latency of carcinogens may be decades, the long-term consequences of inhaling benzene-laden burning jet fuel among those exposed in 2003 may not be evident even in 2021. We propose independent, academic peer-reviewed NIH or NIOSH-funded monitoring centers for affected patients. We acknowledge VA funding for this issue but the reality in 2021 is that most veterans in the greater NYC metropolitan area, for example, do not utilize VA services, since they exceed income limits and are employed in civilian capacities with private health insurance. These longitudinal Centers of Excellence for monitoring would report to Congress annually and engage in a fashion like World Trade Center monitoring programs. We envision centers studying basic animal models and investigations into therapeutic agents, clinical monitoring, clinical trials, and promulgation of education to those pulmonologists treating veterans who typically are seen outside of the Veterans Affairs system. The National VA War Related Illness and Injury Centers are few and do not monitor patients, but rather serve as a consultative body; they do not perform biopsies. We also 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 President-elect Biden's proposal for consideration of presumption of coverage for constrictive bronchiolitis. Even in 2020, 77.7% of veterans requesting compensation and pension medical examinations for maladies beginning in Iraq and Afghanistan are denied medical benefits. After 17 years, the time to acknowledge the sacrifices soldiers have made for our freedom is long overdue. The ATS Workshop in 2019 entitled ''Respiratory Health after Military Service in Southwest Asia and Afghanistan An Official American Thoracic Society Workshop Report'' indicated that it was inconclusive to link constrictive bronchiolitis to war exposures, so this argues for further research. If the Fort Hood cohort was based on fine needle aspirates, then parenchyma was insufficiently sampled, and one cannot make conclusive statements about constrictive bronchiolitis. We are not asserting that constrictive bronchiolitis is prevalent, rather sundry manifestations of lung injury, as cited in our previous work and that of others, includes new-onset, war-related asthma, chronic obstructive pulmonary disease, granulomatous lung disease, titanium lung, lung fibrosis. We agree with the National Academies of Sciences, Engineering, and Medicine who also encourage continued research, through a consensus platform, for biomarkers and peri-deployment pulmonary diagnostic monitoring. We should not just honor those who have sacrificed their lives, but we should also provide needed medical monitoring that we already provide to the brave women and men who sacrificed their health on 9/11.

Medical monitoring is paramount. The institution of a standardized national examination would be useful, but in the context that dyspnea post deployment is multifactorial, objectivity is important.

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