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TITLE: Impact of Open Burn Pit Exposure on Respiratory and Cardiovascular Health

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CONTRACTING ORGANIZATION: BROWN UNIVERSITY IN PROVIDENCE IN THE

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14. ABSTRACT Lay Abstract The proposed study directly addresses a priority area, Burn Pit Exposure, and would give us the most extensive understanding developed thus far on this topic of great concern to many of the Veterans who served in Afghanistan and Iraq. Our ultimate goal is to determine the best way to provide health care to Veterans who were deployed to Afghanistan and Iraq. This study offers several important strengths over previous studies: (1) We will use information from deployment records to more accurately estimate individual exposures to burn pits; (2) We will link these refined exposure estimates to data on health outcomes from medical records over multiple years following military service to see if there are health problems that continue over time; (3) Restricting the analyses to those who served in Afghanistan and Iraq during the time period in which burn pits were in use will help us pinpoint the effects of burn pits separately from any health effects from deployment more generally. We are trying to find out if exposure to open burn pits during deployment to Afghanistan and Iraq causes respiratory and cardiovascular disease among Veterans. We will address the following specific aims: 1) Is deployment to a military base at which open burn pits were used associated with increased risk of respiratory or cardiovascular disease among Veterans who obtain health care from VA facilities? 2) Is a longer time or more intense exposure to open burn pits associated with a higher risk of disease among Veterans? 3) Does the pattern of disease among Veterans suggest that burn pit exposure is responsible for increased risk? 4) Are there specific diseases associated with open burn pit exposures that need to be studied in more detail? In order to answer these questions, we will link data from four sources: (1) Deployment data for Veterans who served at some time in Afghanistan or Iraq between 2001-2010 when open burn pits were commonly used; (2) Roster data on demographic and other individual attributes; (3) Burn pit use across the different bases and time periods; (4) VA health care data for those who got care through the VA after deployment. We will identify all Veterans who were deployed to Afghanistan or Iraq between 2001 and 2010 and enrolled for care in the VA within a year of discharge from the service, an indicator that they are likely to get a significant proportion of their health care through the VA. We will link the time period and location of deployment to information on when and where burn pits were used. We will focus on respiratory diseases, including asthma, emphysema, bronchitis, chronic obstructive pulmonary disease, and interstitial lung disease, and cardiovascular disease, including hypertension, coronary artery disease (angina, myocardial infarction, percutaneous coronary intervention, coronary artery bypass grafting), congestive heart failure, and cerebrovascular disease. To isolate burn pit exposures from other causes of disease, we will take into account any differences in age, sex, race, rank, service branch, military occupation, education, smoking, and body mass index. The Veterans in our study will be monitored through health records from the time of discharge to the end of 2017. We will find out whether a history of exposure to open burn pits is related to the risk of developing cardiovascular and respiratory diseases. The short-term goal is to find out whether Veterans who were exposed to open burn pits have continuing health problems. Scientifically, this study would help us learn more about health effects of air pollution more generally. The methods for our study could be a model for addressing other questions about the long-term health consequences of military deployment.					
15. SUBJECT TERMS					
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1. INTRODUCTION:

The proposed study directly addresses a priority area, Burn Pit Exposure, and would give us the most extensive understanding developed thus far on this topic of great concern to many of the Veterans who served in Afghanistan and Iraq. Our ultimate goal is to determine the best way to provide health care to Veterans who were deployed to Afghanistan and Iraq. This study offers several important strengths over previous studies: (1) We will use information from deployment records to more accurately estimate individual exposures to burn pits; (2) We will link these refined exposure estimates to data on health outcomes from medical records over multiple years following military service to see if there are health problems that continue over time; (3) Restricting the analyses to those who served in Afghanistan and Iraq during the time period in which burn pits were in use will help us pinpoint the effects of burn pits separately from any health effects from deployment more generally.

2. KEYWORDS: Burn pit, Exposure, Health.

3. ACCOMPLISHMENTS:

What were the major goals of the project?

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Major Task 1: Acquire a roster of service personnel deployed to Afghanistan or Iraq from 2001 to 2010 and enrolled in the VA for care within 1 year of discharge

Major Task 2: Develop a matrix linking deployment dates and locations to open burn pit dates and locations for assigning exposure

Major Task 3: Obtain VA health care records for diagnosed diseases and for inferring tobacco use and BMI.

Major Task 4: Conduct analyses of the relationship of burn pit exposure and the diagnosis of respiratory and cardiovascular disease, and develop a report and manuscripts for publication

What was accomplished under these goals?

Major Task 1: Acquire a roster of service personnel deployed to Afghanistan or Iraq from 2001 to 2010 and enrolled in the VA for care within 1 year of discharge

Major Task 3: Obtain VA health care records for diagnosed diseases and for inferring tobacco use and BMI.

We have made substantial progress in developing the data needed for the analysis, addressing major tasks 1 and 3. The required data from the Veterans Administration has been used for preliminary analysis to generate the outcome data on cardiovascular and respiratory diseases of interest as well as covariate information on demographic and behavioral factors predictive of these diseases. This has involved examining in detail the information available on critical covariates such as smoking and BMI and refining algorithms for their utilization in the study. The analytic work is being done

by staff at the Providence VA and they have extensive experience in working with VA health data that is central to this study.

In addition to the needed health outcome and covariate data, we have developed information on burn pit utilization and thus potential exposure for the 100 largest bases. [TO BE COMPLETED]

The greatest challenge and source of delay has been in obtaining permission to link the deployment data from DoD with the health and covariate data from the VA. After over a year of effort, we have just been informed that the final requirement has been met and we can now proceed to merge the health data set we have been analyzing with the deployment data, which will then be linked to the burn pit exposure data. We anticipate rapid progress as these data sources come together and have made detailed plans for conducting the analysis.

Major Task 2: Develop a matrix linking deployment dates and locations to open burn pit dates and locations for assigning exposure

We received a list of all bases outside the US and their populations per year (person-days) from 2001-2015 from the Defense Manpower Data Center (DMDC). The earliest date of any significant population recording in the DMDC was 2004. Population records show that many soldiers did not have a designated location throughout the period of 2001-2004 (unknown in the Service Personnel Accountability software (SPA) or Empty (most likely a branch service not using SPA until much later such as Navy/Marines). The DMDC list we received did not have country designated and included world wide bases (about 1500 bases), so we merged it with a list of all bases in the middle east received from the U.S. Central Command (CENTCOM) which covers the area from Kazakhstan to Egypt including Iraq and Afghanistan (~978 bases). In addition, we received a third list from CENTCOM comprised of bases identified as ever having a burn pit (~ 500 bases). After merger of these 3 lists, which required manual matching due to many alternate base names and spellings, we produced a working list of bases located in Iraq and Afghanistan where deployment of troops was recorded by the DMDC and maximum annual base population was over 1450 person-days (~530 bases). From these we selected the top 100 bases based on population (a combination of cumulative and maximum yearly).

We then received available files for these top 100 bases from the Department of Defense (DoD) Defense Occupational and Environmental Health Readiness System (DOEHRS). These files contain records of air, soil, ash sampling, public health site assessments, pest control records, and other reports collected by the Preventative Medicine Medical Detachments, Public Health Officers, KBR Inc (pest management), and occasional reports by other countries participating in OEF and OIF.

We have requested assistance from CENTCOM in collecting limited waste disposal data from initial environmental base surveys (EBS), environmental site closure surveys (ESCS) and other environmental condition reports (ECR) collected by CENTCOM Engineering for the top 100 bases. These files are still classified, so we are awaiting assistance from CENTCOM to review these files and fill in the data collection sheets we have developed.

Once all inputs are assembled, each base will be assessed to determine a final timeline of burn pit presence (yes/no) for each year the base was populated according to DMDC records. In addition, we plan to determine the timelines for introduction of medical and general waste incinerators (yes/no).

We will designate a base as a high volume burn pit site in a year when a burn pit was present, based on a cutoff (to be determined) of the DMDC population census of person-days.

What opportunities for training and professional development has the project provided?

While we have not engaged in formal coursework or training exercises, the project has engaged a doctoral student in Epidemiology, Rachel Gaither, as a Research Assistant and in that capacity she has become quite knowledgeable about the VA health data resources, the algorithms for coding of cardiovascular and respiratory disease, and more generally, the use of administrative databases for health research.

How were the results disseminated to communities of interest?

Nothing to Report

What do you plan to do during the next reporting period to accomplish the goals?

We will be integrating the three data streams needed for the study – the health and covariate data from the VA, the deployment data from the DoD, and the burn pit exposure matrix linking bases to burn pit utilization. More specifically, this will involve:

- 1) Refining the cohort composition to accommodate the available deployment and exposure data, possibly having to restrict eligibility to those who were deployed during the calendar time periods for which data are available, with sufficiently complete deployment histories, if substantial gaps are found as we examine the data, and who were deployed for substantial periods of time to bases for which the burn pit utilization is known.
- 2) With the linkage of deployment and burn pit exposure information we will develop exposure indices taking the duration of time of exposure and possibly estimated intensity of exposure into account. This will involve examining multiple indices (without knowledge of outcomes to avoid bias) and making decisions on a small number of the most informative indices that are not too highly correlated with one another.
- 3) We will develop and begin implementing the work plan for the final analysis, examining the relationship between history of burn pit exposure and incidence of cardiovascular and respiratory disease.
- 4) We will develop abstracts and publications concerning the study methods, the use of the deployment data (which is among the very first projects to do so), and possibly some initial results.

4. IMPACT:

What was the impact on the development of the principal discipline(s) of the project?

While the research approach is not novel, to our knowledge, the deployment data from DoD and the health outcome data from the VA have never been linked in a study of this nature. If we are successful in demonstrating that this approach is informative, and we have every reason to believe it will be, it could become a widely used strategy to examine the relationship between experiences while in military service and long-term health consequences.

What was the impact on other disciplines?

Nothing to report.

What was the impact on technology transfer?

Nothing to report.

What was the impact on society beyond science and technology?

Nothing to report.

5. CHANGES/PROBLEMS:

Changes in approach and reasons for change

As we have become familiar with the data, we have made refinements in the composition of the cohort and the approach to burn pit exposure classification. These are not deviations from the original plans but adjustments in light of the available data.

Actual or anticipated problems or delays and actions or plans to resolve them

Obtaining the needed data from DoD has proven to be extremely challenging, but that has finally been resolved and we do not anticipate technical problems in linking the deployment data to the health and covariate data from the VA.

Changes that had a significant impact on expenditures

No changes to report.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

No changes to report.

Significant changes in use or care of human subjects

No changes to report.

Significant changes in use or care of vertebrate animals

No changes to report.

Significant changes in use of biohazards and/or select agents

No changes to report.

6. PRODUCTS:

Publications, conference papers, and presentations

None to report.

Journal publications.

None to report.

Books or other non-periodical, one-time publications.

None to report.

Other publications, conference papers and presentations.

None to report.

Website(s) or other Internet site(s)

None to report

Technologies or techniques

None to report

Inventions, patent applications, and/or licenses

None to report

Other Products

None to report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

<i>Name:</i>	David Savitz
<i>Project Role:</i>	Contact PI
<i>Researcher Identifier (e.g. ORCID ID)</i>	0000-0002-3475-4113
<i>Nearest person month worked:</i>	2.0 Academic Months, 0.4 Summer Months
<i>Contribution to Project:</i>	Project leadership, oversight of analysis of VA health and covariate data, guidance on completing data acquisition

<i>Name:</i>	Susan Woskie
<i>Project Role:</i>	PI subcontract and Exposure Scientist
<i>Researcher Identifier (e.g. ORCID ID)</i>	0000-0003-1562-1945
<i>Nearest person month worked:</i>	1 Summer Month
<i>Contribution to Project:</i>	Leadership of exposure assessment, working with DoD to acquire and interpret available data for burn pit exposure assignment

<i>Name:</i>	Anila Bello
<i>Project Role:</i>	Exposure Research Scientist
<i>Nearest person month worked:</i>	4.8 Calendar Months
<i>Contribution to Project:</i>	Collaborating investigator with Dr. Woskie on all issues related to burn pit exposure assessment

<i>Name:</i>	Joseph Gasper
<i>Project Role:</i>	Site PI
<i>Researcher Identifier (e.g. ORCID ID)</i>	0000-0003-1383-6205
<i>Nearest person month worked:</i>	1 Calendar Month
<i>Contribution to Project:</i>	Consultation on analytic strategy for use of VA health data

<i>Name:</i>	Greg Wellenius
<i>Project Role:</i>	Site PI
<i>Researcher Identifier (e.g. ORCID ID)</i>	0000-0003-0427-7376
<i>Nearest person month worked:</i>	2.0 Academic Months, 0.4 Summer Months
<i>Contribution to Project:</i>	Consultation on epidemiologic and statistical

	methods for study design and analysis
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<i>Name:</i>	Rachel Gaither
<i>Project Role:</i>	Graduate RA
<i>Researcher Identifier (e.g. ORCID ID):</i>	0000-0002-9051-4798
<i>Nearest person month worked:</i>	3.6
<i>Contribution to Project:</i>	Literature acquisition for disease classification algorithms, tabulation of analysis results

<i>Name:</i>	Amal Trivedi
<i>Project Role:</i>	Co-Investigator
<i>Researcher Identifier (e.g. ORCID ID):</i>	0000-0002-9695-4727
<i>Nearest person month worked:</i>	1.2
<i>Contribution to Project:</i>	Leadership of VA subcontract, guidance on interpretation of VA medical data and disease classification algorithms

<i>Name:</i>	Dawn Mello
<i>Project Role:</i>	Co-Investigator
<i>Nearest person month worked:</i>	1.2
<i>Contribution to Project:</i>	Project management within the VA, work with DoD on obtaining access to deployment data

<i>Name:</i>	Lan Jiang
<i>Project Role:</i>	Co-Investigator
<i>Nearest person month worked:</i>	1.2
<i>Contribution to Project:</i>	Conduct of all data analysis on VA health and covariate information

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Nothing to Report

What other organizations were involved as partners?

Nothing to Report

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS:

Not Applicable

QUAD CHARTS:

Attached

9. APPENDICES:

Not Applicable



Impact of Open Burn Pit Exposure on Respiratory and Cardiovascular Health Among Military Veterans
 PR181512 DEPARTMENT OF THE ARMY US ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY
 W81XWH1910763

PI: David Savitz Org: Brown University Award Amount: \$1,472,838

Study/Product Aim(s)

- 1) Enumerate service personnel deployed to Afghanistan or Iraq during the period in which open burn pits were utilized, 2001-2010, who subsequently left the service and enrolled for VA care within one year of discharge from the service (estimated as 1.25 million people) and link deployment data to the DoD roster file for individual demographic and related attributes. This large subset of Veterans will constitute the study population of interest;
- 2) Develop an exposure matrix to link dates and bases to open burn pit use, with additional refinements in burn pit exposure categories contingent on data availability (burn pit content, base size/pit volume; occupational codes);
- 3) Match individual deployment dates and locations from the DoD roster file to the exposure matrix to develop individual exposure assignments;
- 4) Obtain VA health care records to assess health outcomes through 2017, and for determining tobacco use and body mass index (BMI) as potential confounders.

Approach

With this information, we will be able to address the following research questions:

- 1) Is a history deployment to a military base at which open burn pits were used associated with an increased risk of respiratory or cardiovascular disease among Veterans who obtain health care from VA facilities?
- 2) Is duration or duration combined with intensity of potential exposure to open burn pits associated with a dose- response gradient for respiratory or cardiovascular disease among Veterans?
- 3) Are associations with respiratory or cardiovascular diseases specific to these health outcomes as indicated by an absence of association with health outcomes that are very unlikely to be caused by open burn pit exposures?
- 4) Does the pattern of association among the categories of respiratory and cardiovascular disease suggest diseases processes that warrant more detailed investigation in future studies?

Identified process for securing needed data from the VA
 Initial evaluation of deployment data

Timeline and Cost

Activities	CY	20	21	22
Major Task 1: Acquire roster of service personnel deployed to Afghanistan or Iraq from 2001-2010 and enrolled in the VA for care within 1 year of discharge				
Major Task 2: Develop a matrix linking deployment dates and locations to open burn pit dates and locations for assigning exposure				
Major Task 3: Obtain VA health care records for diagnosed diseases and for inferring tobacco use and BMI.				
Major Task 4: Conduct analyses of the relationship of burn pit exposure and the diagnosis of respiratory and cardiovascular disease, and develop a report and manuscripts for publication				
Estimated Budget \$1,472,838		\$409,962	\$687,419	\$375,455

Goals/Milestones

CY20 Goal – Develop detailed plans for obtaining needed data on burn pit exposure potential from DoD and health outcomes from the VA

Plans have been established and are being pursued

CY21 Goals – Complete data exploration and acquisition for conducting analyses

Obtain health data from the VA to select study population and develop algorithms for disease identification

Obtain deployment history data and burn pit time and location data from DoD

CY22 Goal – Conduct analyses assessing the association between burn pit exposure and long-term cardiovascular and respiratory disease

Develop final results report and manuscripts for publication

Comments/Challenges/Issues/Concerns

- We have had challenges in obtaining the data from both VA and DoD but have resolved these and have clear plans to go forward

Budget Expenditure to Date

Projected Expenditure: \$687,419

Actual Expenditure: \$560,970*

**Due to issues that delayed acquisition of the data for this study, spending has lagged but a new plan is being established to accelerate the progress has begun.*

Updated: (September 1, 2021)