

AWARD NUMBER: W81XWH-17-1-0019

TITLE: Human Head Impact Dose Concussion Risk Functions and Sensor-Based Military-Specific Environmental Monitoring System

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REPORT DATE: 14 FEBRUARY 2019

TYPE OF REPORT: ANNUAL

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. REPORT DATE 14 FEBRUARY 2019			2. REPORT TYPE ANNUAL			3. DATES COVERED 15JAN2018 - 14JAN2019		
4. TITLE AND SUBTITLE Human Head Impact Dose Concussion Risk Functions and Sensor-Based Military-Specific Environmental Monitoring System						5a. CONTRACT NUMBER		
						5b. GRANT NUMBER		
						5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) ADAM BARTSCH E-Mail: ABARTSCH@PREVENTBIOMETRICS.COM						5d. PROJECT NUMBER W81XWH-17-1-0019		
						5e. TASK NUMBER		
						5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) PREVENT BIOMETRICS 4530 WEST 77 TH STREET SUITE 300 MINNEAPOLIS, MN 55435						8. PERFORMING ORGANIZATION REPORT NUMBER 01		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012						10. SPONSOR/MONITOR'S ACRONYM(S)		
						11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited								
13. SUPPLEMENTARY NOTES								
14. ABSTRACT Study Aims: <ol style="list-style-type: none"> 1. Quantify head impact exposure during military training and sporting activities in military service cadets, civilian athletes, and in active duty military personnel. <ul style="list-style-type: none"> • Characterize differing exposure across a variety of contact sports and military activities, for helmeted and non-helmeted sports, and in males and females. 2. Correlate head impact exposure with the onset and severity of concussion. <ul style="list-style-type: none"> • Quantify the role of number, severity, frequency and direction of head impacts leading up to the onset of concussion. • Develop injury risk functions for the onset of concussion based on cumulative head impact exposure. 3. Correlate head impact exposure with clinical outcomes (e.g., symptoms, cognition, balance) in the absence of concussion and develop head impact exposure risk functions associated with concussion onset and clinical changes. <ul style="list-style-type: none"> • Quantify factors most associated with concussion onset and clinical changes • Develop injury risk functions for clinical changes in the absence of concussion based on cumulative head impact exposure. 4. Quantify head impact exposure during basic training and combat training activities in football athletes at Air Force Academy and West Point that are also enrolled in CARE 2.0. Determine if the increased head impact burden at the service academies is responsible for higher rates of concussion in those football athletes. 5. Assist USAARL in laboratory testing to develop standard means to quantify sensitivity and specificity of head impact dosimeters in TD and PMHS tests. 								
15. SUBJECT TERMS NONE LISTED								
16. SECURITY CLASSIFICATION OF:				17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON		
a. REPORT	b. ABSTRACT	c. THIS PAGE		Unclassified	5	USAMRMC		
Unclassified	Unclassified	Unclassified				19b. TELEPHONE NUMBER (include area code)		

Table of Contents

Page

1. Introduction.....	4
2. Keywords.....	4
3. Accomplishments.....	4
4. Impact.....	5
5. Changes/Problems.....	5
6. Products, Inventions, Patent Applications, and/or Licenses.....	5
7. Participants & Other Collaborating Organizations.....	5
8. Special Reporting Requirements.....	5
9. Appendices.....	5

1. Introduction

This study has five (5) Specific Aims:

- Quantify head impact exposure during military training and sporting activities in military service cadets, civilian athletes, and in active duty military personnel.
 - Characterize differing exposure across a variety of contact sports and military activities, for helmeted and non-helmeted sports, and in males and females.
- Correlate head impact exposure with the onset and severity of concussion.
 - Quantify the role of number, severity, frequency and direction of head impacts leading up to the onset of concussion.
 - Develop injury risk functions for the onset of concussion based on cumulative head impact exposure.
- Correlate head impact exposure with clinical outcomes (e.g., symptoms, cognition, balance) in the absence of concussion and develop head impact exposure risk functions associated with concussion onset and clinical changes.
 - Quantify factors most associated with concussion onset and clinical changes
 - Develop injury risk functions for clinical changes in the absence of concussion based on cumulative head impact exposure.
- Quantify head impact exposure during basic training and combat training activities in football athletes at Air Force Academy and West Point that are also enrolled in CARE 2.0. Determine if the increased head impact burden at the service academies is responsible for higher rates of concussion in those football athletes.
- Assist USAARL in *laboratory testing to develop standard* means to quantify sensitivity and specificity of head impact dosimeters in TD and PMHS tests.

Administrative functions of this study will be performed at the Medical College of Wisconsin (MCW) in Milwaukee, WI.

Data collection for this study will be performed through the following Institutions:

- United States Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL
- United States Air Force Academy (USAFA), Colorado Springs, CO
- United States Military Academy (USMA), West Point, NY
- Concordia University Wisconsin (CUW), Mequon, WI
- Carroll University (CU), Waukesha, WI
- Wisconsin Lutheran College (WLC), Milwaukee, WI
- Carthage College (CC), Kenosha, WI

2. Keywords

Environmental Sensors in Training (ESiT), Combatives, CARE, Concussion, Impact dose

3. Accomplishments

The project is spinning up to be operational along the submitted plan of action. In the past year, the following have been accomplished:

- The award was formally transferred from Cleveland Clinic to Prevent Biometrics
- The sub-contract between Prevent Biometrics and Medical College of Wisconsin (MCW) was issued
- The MCW IRB was submitted and approved locally
- The approved MCW IRB was submitted for HRPO review
- The USAARL review for testing on PMHS has been submitted
- Two (2) on-site meetings at USMA with Dr. Adam Bartsch (Prevent Biometrics), Dr. Ken Cameron, Dr. Megan Houston and Mr. Tyler Rooks (USAARL) have taken place to coordinate the concept of operations
- Two (2) on-site meetings at USAFA with Drs. Bartsch, Jerry McGinty and Lt. Col. Scott Dixon have taken place to coordinate the concept of operations
- A meeting was held at the 2019 CARE Meeting in Chicago with Drs. Bartsch, Stemper/McCrea (MCW), Cameron/Houston (USMA), McGinty (USAFA), Shoge/Vu (USAMRC) and Lt. Col. Paul Pasquina (USHUS) to coordinate and delineate cooperative agreement activities in parallel with ongoing DOD-NCAA CARE Consortium activities.
- A meeting was held at USAARL Ft. Rucker with Dr. Bartsch, Mr. Rooks and Mr. Joe McEntire to discuss enrollment/logistics of conducting (1) combatives impact dosimetry and (2) laboratory calibration testing of sensors in ATD and PMHS.
- We are on-track in all areas of the project plan. Assuming HRPO review occurs along normal schedule it is anticipated data collection begins in earnest ~Q3/2019 at MSA's and MCW schools.

4. Impact

We have successfully identified how to leverage this Project as an additive and complimentary component to the DOD’s investment in the CARE Consortium. This Project will allow expanded monitoring of military members and deeper knowledge of head impact doses and exposures to potentially injurious effects beyond the already impressive scope of CARE Consortium.

5. Changes/Problems

Nothing to report.

6. Products, Inventions, Patent Applications and/or Licenses

None to report.

7. Participants & Other Collaborating Organizations

Name:	<i>Adam Bartsch PhD PE</i>
Project Role:	<i>PI</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>1</i>
Contribution to Project:	<i>Dr. Bartsch has worked to get the IRB and HRPO reviews initiated, getting award and sub-contract in place, and getting USMA and USAFA aligned with the concept of operations once HRPO review is completed.</i>
Funding Support:	<i>Prevent Biometrics, NIH</i>

8. Special Reporting Requirements

None to report.

9. Appendices

N/A.