AWARD NUMBER:	W81XWH-14-2-0141
TITLE:	Development of Predictive Models of Injury for the Lower Extremity, Lumbar, and Thoracic Spine after discharge from Physical Rehabilitation
PRINCIPAL INVESTIGATOR:	Dr. Daniel Rhon
CONTRACTING ORGANIZATION:	U.S. Army Brooke Army Medical Center (BAMC) The Geneva Foundation Lackland AFB TX 78236
REPORT DATE:	October 2018
TYPE OF REPORT:	Annual
PREPARED FOR:	U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012
DISTRIBUTION STATEMENT:	Approved for Public Release; Distribution Unlimited

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	**2. REPORT TYPE**	**3. DATES COVERED**
October 2018	Annual Report	22Sep2017 - 21Sep2018

4. TITLE AND SUBTITLE

Development of Predictive Models of Injury for the Lower Extremity, Lumbar, and Thoracic Spine after discharge from Physical Rehabilitation

5a. CONTRACT NUMBER

5b. GRANT NUMBER
W81XWH-14-2-0141

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Dr. Daniel Rhon

E-Mail: Daniel.i.rhon.ctr@mail.mil

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

U.S. Army Brooke Army Medical Center (BAMC)
The Geneva Foundation
Lackland, AFB TX 78236

8. PERFORMING ORGANIZATION REPORT NUMBER

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

The objective and overall hypothesis is that service member performance on a battery of physical performance tests performed upon discharge from physical rehabilitation, will be able to predict 1) the risk of sustaining any injury as well as 2) the risk of reoccurrence of the same injury. A two-pronged injury prevention approach is required to optimize return to duty rates after injury: Screening for known preventable musculoskeletal risk factors and ensuring these risk factors are mitigated prior to discharge from rehabilitation. The current assumption is that a service member discharged from medical care is ready to return to full duty. Because history of prior injury is a well-established risk factor, every service member that is discharged from Physical Rehabilitation is already at a higher risk for future injury. Identifying those at increased risk of recurrence provides the ability for secondary and tertiary prevention programs to optimize return to duty rates. **Hypothesis 1:** Risk factors shown to be predictive of lower extremity and lumbar/thoracic spine injuries in other populations and in healthy service members will also be predictive of re-occurrence of original injury, future injury, and return to duty rates in service members being discharged from Physical Rehabilitation. **Hypothesis 2:** The injury prediction models will vary by age and sex. **Hypothesis 3:** A multi-factorial prediction model that accurately predicts risk of new and recurring injuries, as well as return to duty rates, will consist of multiple variables.

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**			USAMRMC
Unclassified	Unclassified	Unclassified	Unclassified	8	**19b. TELEPHONE NUMBER** *(include area code)*

Table of Contents

Page

The text of the report must include all sections addressed in the table of contents to include the following. **DO** include the bolded section headings, but **DO NOT** include the *italicized* descriptions of section contents in your submitted reports.

1. **INTRODUCTION:**

Musculoskeletal injuries have a significant deleterious effect on Soldier readiness. Screening algorithms for injury risk have been identified, but have not been evaluated in service members returning to duty after an injury. As past injury and pain with movement are strong risk factors for future injury, the ability to adequately screen service members for injury risk after they have been cleared to return to duty from an injury is of great importance. The purpose of this project is to determine if performance on a battery of functional tests after discharge from medical care, can predict risk for injury after returning to full duty following a spine or lower extremity injury.

2. **KEYWORDS:**

Injury prevention, injury prediction, injury risk, musculoskeletal, lower extremity, spine, return to duty

3. **ACCOMPLISHMENTS:**

What were the major goals of the project?

Milestone 1: IRB approval and HRPO Approval (Initial Target – 6-8 months)
- STATUS – IRB approval at all sites with the primary site being approved on 26 February 2015 and the last sub-site approval on 25 February 2016.

Milestone 2: Target recruitment met (Initial Target – 24 months)
- STATUS- 480 subjects enrolled (220 at WBAMC, 254 at WAMC, and 6 at BAMC). We were delayed by over a year hitting this goal.

Milestone 3: 1-year injury surveillance complete (Initial Target – 36 months)
- STATUS – Complete. All 480 subjects crossed their 1-year period of surveillance.
Milestone 4: Analysis for Primary Aims complete (42 months)
- STATUS - (not started) – data is being cleaned and healthcare utilization will be abstracted from MDR. at the beginning of 2019. Then MDR data will be merged with the other data collected in order to run the required analyses.

What was accomplished under these goals?

The past year focused solely on completing the 1-year follow-up for all subjects. The delays with IRB Approval due to IRBNet going away and adoption of eIRB put us about 10-12 months behind schedule. However, we did manage to complete enrollment and 1-year follow-up for all 480 subjects during this last year and are in great position now to move into the analysis phase.

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

Although our project was no intended to provide training and professional development, there have been several opportunities to do so. The MEDCOM Executive Health program implemented at BAMC utilized some of the screening components from this study, and our team provided the relevant training to healthcare providers on these injury screening procedures. Dr. Rhon and COL Teyhen were able to lead a session on injury prevention at the 4th International Congress on Soldier Physical Performance which was well received.

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?

As we just finished the 1-year follow-up and surveillance phase for all of our subjects, this next year will entail cleaning and prepping the data for analyses. We have to wait 90 days after the last follow-up completion before we pull the 1-year healthcare utilization data from MDR. Then we will need to clean and merge the data with the data we collected at baseline and monthly self-report injury surveys. The data cleaning and merging should take us into the 2nd quarter of CY 2019, and then we hope to have the algorithms finalized before then of the FY.

4. **IMPACT:**

What was the impact on the development of the principal discipline(s) of the project?
Nothing to Report

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 the focus was on predicting return to duty after injury, we expanded our recruitment footprint to include musculoskeletal injuries in primary care.

Actual or anticipated problems or delays and actions or plans to resolve them
Nothing that has not been reported previously.

Changes that had a significant impact on expenditures
Nothing that has not been reported previously.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents
None

Significant changes in use or care of human subjects
None

Significant changes in use or care of vertebrate animals. N/A

Significant changes in use of biohazards and/or select agents. N/A

6. **PRODUCTS:**

Publications, conference papers, and presentations
Presentation at 4th International Congress on Soldier Physical Performance
Are we trying to prevent injuries or prevent disability? Why it matters. https://doi.org/10.1016/j.jsams.2017.09.085
Predicting injuries in the military: What works, what doesn't, and does it even matter? https://doi.org/10.1016/j.jsams.2017.09.080

Journal publications.
Rhon DI, Teyhen DS, Shaffer SW, Goffar SL, Kiesel K, Plisky PP. *Developing predictive models for return to work using the Military Power, Performance and Prevention (MP3) musculoskeletal injury risk algorithm: a study protocol for an injury risk assessment programme*. Injury Prevention. 2016 Nov 24. pii: injuryprev-2016-042234. doi: 10.1136/injuryprev-2016-042234,
Acknowledgement of federal support: YES

Books or other non-periodical, one-time publications.
Nothing to Report

Other publications, conference papers, and presentations.
Nothing to Report

Website(s) or other Internet site(s)
Nothing to Report

Technologies or techniques
Nothing to Report

Inventions, patent applications, and/or licenses
Nothing to Report

Other Products
Nothing to Report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name:	*Dr. Dan Rhon*
Project Role:	*Primary Investigator*
Researcher Identifier (e.g. ORCID ID):	*0000-0002-4320-990X*
Nearest person month worked:	*3*
Contribution to Project:	*Writing IRB protocols for all 4 sites; Coordinating training at 2 main sites. Traveled to all 4 sites for site visits, coordinate with local IRBs, and help deliver training to research team. Continued oversight of all sites.*
Funding Support:	*N/A*
Name:	*Dr. Matt Hartshorne*
Project Role:	*Research Physical Therapist*
Researcher Identifier (e.g. ORCID ID):	*N/A*
Nearest person month worked:	2
Contribution to Project:	*Local assistance with IRB at Womack site. Assistance with setting up and planning local training meeting. Putting together study material for local site. In charge of enrollment/recruitment at local site. Updating protocols and other IRB documents as necessary.*
Funding Support:	*100%*
Name:	*Dr. Tina Greenlee*
Project Role:	*Research Associate*
Researcher Identifier (e.g. ORCID ID):	*N/A*
Nearest person month worked:	*6*
Contribution to Project:	*Local assistance with IRB at BAMC site. Assistance with setting up and planning local training meeting. Putting together study material for local site. Help with enrollment/recruitment at local site. Updating protocols and other IRB documents as necessary.*
Funding Support:	*100%*
Name:	*Dr. Rachel Mayhew*
Project Role:	*Research Physical Therapist*
Researcher Identifier (e.g. ORCID ID):	*N/A*
Nearest person month worked:	*3*
Contribution to Project:	*Local assistance with IRB at BAMC site. Assistance with setting up and planning local*

	training meeting. Putting together study material for local site. In charge of enrollment/recruitment at local site. Updating protocols and other IRB documents as necessary.
Funding Support:	*100%*
Name:	*COL Deydre Teyhen*
Project Role:	*Associate Investigator*
Researcher Identifier (e.g. ORCID ID):	*N/A*
Nearest person month worked:	*1*
Contribution to Project:	*Consultation and input for planning, data collection, and follow-on steps after study.*
Funding Support:	*100%*

8. **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?

Organization Name: University of Evansville
Location of Organization: Evansville, IN
Partner's contribution to the project

In-kind support: Contributed to the study design and provide consultation throughout the study enrollment process. Dr. Phil Plisky and Dr. Kyle Kiesel have an extensive history of this line of work with professional athletes. They will be more active in this final year as we work on the predictive statistical models. Some of the grant funds also went to help adapt the MP3 software for data collection pertinent to this particular study.

9. **SPECIAL REPORTING REQUIREMENTS**
COLLABORATIVE AWARDS: N/A

QUAD CHARTS: *Attached*

10. **APPENDICES:** None

Development of Predictive Models of Injury for the Lower Extremity, Lumbar, and Thoracic Spine after Discharge from Physical Rehabilitation

ERMS# 13063063.
Award # W81XWH-14-2-0141

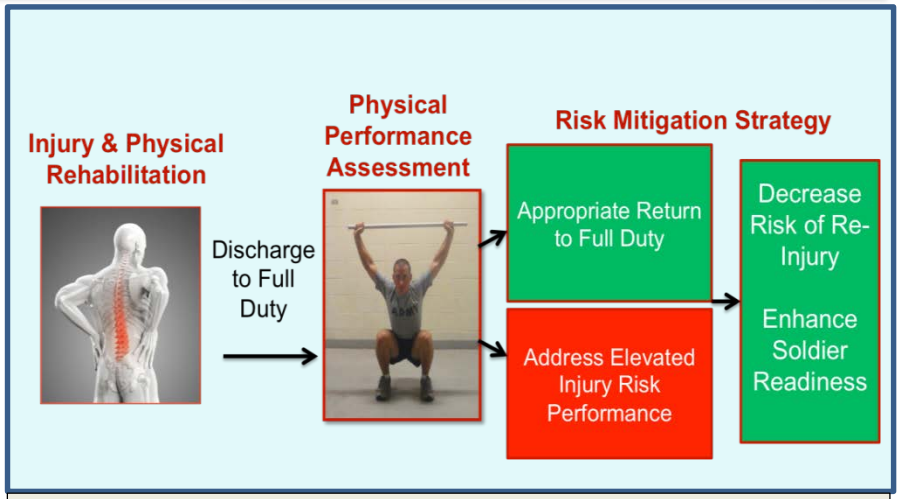
PI: MAJ Daniel Rhon **Org:** The Geneva Foundation **Award $**1,084,186

Study/Product Aim(s)

- **Aim 1:** To improve prediction of injury-free, we will compare and contrast select performance test results in service members that sustain an injury versus those that do not during the 12-month follow-up period.
- **Aim 2:** Develop predictive models from collected variables in order to derive a multi-factorial injury risk prediction algorithm.
- **Aim 3**: Develop an optimal physical performance standard that should be met prior to discharge from physical rehabilitation with the aim of decreasing future injury risk and facilitating successful injury-free return to duty.

Approach

- Screen 480 Soldiers being discharged from physical rehabilitation
- Prospectively follow them for one year to identify injuries.
- Screening process includes movement and balance screens, measures of power, demographic data and biopsychosocial measures.
- Injury data will be collected through self-report, profile data, and healthcare utilization data. Clinical prediction rules will be used for algorithm development.



Accomplishment: Enrollment goal has been met (480 subjects enrolled). We are now in the 1-year surveillance period.

Activities FY	14	15	16	17	18	19
IRB Approval, hiring and training of support personnel		■	■			
Subject enrollment and data collection and 1-year follow-up.				■	■	
Healthcare utilization pull from DoD database & medical records					■	■
Data analysis, interpretation, prediction model derivation, and reporting of results						■
Estimated Budget ($1084K)	$407K	$380K	$237K	$60K		

Updated: 21 October 2017

Goals/Milestones

CY14 Goal – System Development/Demonstration
✓Optimal testing pathways established & tested
CY15 Goals – Data Collection
✓ IRB protocol submission/approval (submission only)
✓ HRPO Approval
CY16 Goal – Data Collection
✓ Initiate subject recruitment early 2016
✓ Collect follow up data regarding Injuries incurred for those enrolled
CY17 Goal – Data Collection (enrollment complete)
CY18 Goal – Data Collection (1-year follow-ups complete)
✓ Clean data collected from M2P software and MOSIO
CY19 Goal
❑ Request HCU data from MDR
❑ Develop prediction algorithms based on findings
❑ Risk mitigation strategies developed and linked to predictor variables

Comments/Challenges/Issues/Concerns

The delays in receiving USAMRAA approval to change sites and regular IRB approval due to IRBNET changeover had put us significantly behind.

Budget Expenditure to date

Projected Expenditure: $1084K Actual Expenditure: $730K