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**TITLE:** Patients with Traumatic Injury Transported by Critical Care Air Transport Teams (CCATT):  
The Influence of Altitude and Oxygenation During Transport

**PRINCIPAL INVESTIGATOR:** Shelia Savell, PhD, RN

**CONTRACTING ORGANIZATION:** Wilford Hall Ambulatory Surgical Center

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**14. ABSTRACT**

Background: During previous military conflicts, the US Air Force Critical Care Air Transport Teams (CCATTs) transported critical patients out of theater to Landstuhl Regional Medical Center (LRMC) with cabin pressures equivalent to an altitude of 5,000 to 8,000 feet. Reduced barometric pressure is associated with decreased partial pressure of oxygen, which may contribute to hypoxia; and gas expansion, which may lead to trapped air in body cavities. Other in-flight stressors include acceleration, low humidity, thermal instability, vibration, and noise. These stressors may lead to secondary injuries or exacerbation of initial injuries. In order to avoid this theoretical risk, in theater medical providers, such as validating flight surgeons (VFSs), are tasked with determining if cabin altitude restrictions (CAR) to 4,000 – 6,000 feet should be prescribed for individual patients. Medical evacuation with CAR is not without risks. There is increased risk of turbulence and structural stress on the aircraft. Potential exposure to mountainous terrain, inclement weather, increased flight duration, and increased fuel consumption are all considerations associated with cabin altitude restriction. These operational concerns may contribute to an organizational resistance to the prescription of CAR. Thus, the prescription of CAR must weigh potential benefits to the patient with potential operational risks as described above.

Objective: The purpose of the proposed study is to describe and compare CCATT trauma patients transported with CAR and without CAR to evaluate the impact of CAR on clinical outcomes for trauma populations other than TBI.

Specific Aims:

1. To determine if altitude is related to outcomes or survival of patients with moderate to severe non-TBI traumatic injury.
2. To determine if normoxemia, hypoxemia, or hyperoxemia during CCATT missions are associated with worse outcomes or decreased survival in patients with moderate to severe traumatic injury.

Study Design: We will conduct a retrospective cohort study to compare patients with non-TBI traumatic injury who flew with CAR to those who did not fly with CAR (nonCAR). Patients will be in the CAR group if they have a documented CAR or maximum cabin altitude of 5000 feet or lower in their CCATT record. We will perform a chart review of CCATT patients with moderate to severe (ISS >12) traumatic injury transported out of the combat theater between January 2007 and December 2020.

Impact: This study has the potential to expose the effects of various levels of oxygenation and altitude on the outcomes of military patients with traumatic injury transported by CCATT. Understanding the effects of flight and the management of oxygen administration during flight will help inform the care of and the development of clinical practice guidelines for this patient population and lead to improved patient outcomes. Preventing secondary injury has the potential to allow wounded warriors to return to duty, obtain civilian employment, and remain functional members of their families and society.

**15. SUBJECT TERMS**

Combat casualty, CCATT evacuation, Altitude, Traumatic injury

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## 1. INTRODUCTION:

The purpose of the proposed study is to describe and compare CCATT trauma patients transported with CAR and without CAR to evaluate the impact of CAR on clinical outcomes for trauma populations other than TBI. We will conduct a retrospective cohort study to compare patients with non-TBI traumatic injury who flew with CAR to those who did not fly with CAR (nonCAR). Patients will be in the CAR group if they have a documented CAR or maximum cabin altitude of 5000 feet or lower in their CCATT record. We will perform a chart review of CCATT patients with moderate to severe (ISS >12) traumatic injury transported out of the combat theater between January 2007 and December 2020.

## 2. KEYWORDS:

Combat casualty, CCATT evacuation, Altitude, Traumatic injury

## 3. ACCOMPLISHMENTS:

**What were the major goals of the project?**

Specific Aim 1: To determine if altitude is related to outcomes or survival of patients with moderate to severe non-TBI traumatic injury.

Specific Aim 2: To determine if normoxemia, hypoxemia, or hyperoxemia during CCATT missions are associated with worse outcomes or decreased survival in patients with moderate to severe traumatic injury.

	<b>Due</b>	<b>Achieved</b>
Major Task 1: Obtain required approvals and agreements.	Mar 23	Mar 23
Major Task 2: Hire and train staff for study sites	Mar 23	Dec 22
Major Task 3: Data collection 45% complete	Mar 24	Ongoing
Major Task 4 Data Analysis/Dissemination	Sept 24	

## What was accomplished under these goals?

Major Task 1: Obtain required approvals and agreements.

- 1 Apr 2022 - FINAL IRB DETERMINATION - EXEMPT STUDY
- MOU with ERCC (CCATT) Pilot Unit previously in place.
- Data Sharing Agreement Application with DHA complete, reviewed by JTS, and submitted.
- 06 Mar 2023 – DHA DSA approved and fully executed.

Major Task 2: Hire and train staff for study sites.

- Hired 2 experienced & known research nurse coordinators.
- Both staff in-processed and trained.
- Staff provided with resources and working to meet project objectives.

Major Task 3: Data collection

- Study data base has been created and is currently being tested by abstractors.
- Draft abstraction guide complete.
- Study data base test complete, minor revisions accomplished.
- Abstraction guide revised.
- Interrater agreement addressed in meetings and with early QA processes.
- 28 Dec. 2022 - Mod to add personnel and update Clinical/DHA data base sources.
- 14 June 2023 – Data received from JTS.
- Periodic Quality Assurance activities and bi-monthly meetings with data abstractors.
- JTS data - 1460 casualties met inclusion criteria – 45% (n=663) abstracted

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

Nothing to Report.

**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?**

Continue chart abstraction and quality assurance activities. Complete interim analysis on a sample of patients.

**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**

There are no problems to report. We are on track to complete project per SOW.

**Changes that had a significant impact on expenditures**

Nothing to report.

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

**Significant changes in use or care of human subjects**

N/A

**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**

- **Journal publications.**

Nothing to Report.

**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)**

N/A

- **Technologies or techniques**

Nothing to Report

- **Inventions, patent applications, and/or licenses**

Nothing to Report

- **Other Products**

The ACCESS data base for this study will be a comprehensive collection of inflight data, JTS outcome data, and other casualty information. We intend to obtain IRB approval to add this de-identified data to the En route Care Research Center Repository. Researchers with approved IRB protocols will be able to request de-identified data in the future to answer additional research questions.

## 7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

**What individuals have worked on the project?**

**Name:** *Shelia Savell*  
**Project Role:** *PI*  
**Researcher Identifier (e.g. ORCID ID):** *0000-0002-8684-2764*  
**Nearest person month worked:** *1*  
**Contribution to Project:** *Dr. Savell tracks data related to numbers of casualties screened, included, and abstracted. Facilitates team meetings and tracks project progress. Monitors QA processes. Has now assumed PI role.*

**Name:** *Ryan Earnest*  
**Project Role:** *AI*  
**Researcher Identifier (e.g. ORCID ID):**  
**Nearest person month worked:** *1*  
**Contribution to Project:** *Dr. Earnest consults as needed for abstraction and data base revisions.*

**Name:** *Julie Cutright*  
**Project Role:** *Research Nurse Coordinator/QA*  
**Researcher Identifier (e.g. ORCID ID):**  
**Nearest person month worked:** *1*  
**Contribution to Project:** *Ms. Cutright provides oversight for data tracking and quality assurance.*

**Name:** *Darrin Baldwin*  
**Project Role:** *Project Lead Nurse Research Coordinator*  
**Researcher Identifier (e.g. ORCID ID):**  
**Nearest person month worked:** *2*  
**Contribution to Project:** *Responsible for meeting project regulatory requirements. Data collection - Abstracts data from casualty records. Maintains study records.*

**Name:** *Jill Lear*  
**Project Role:** *Nurse Research Coordinator*  
**Researcher Identifier (e.g. ORCID ID):**  
**Nearest person month worked:** *2*  
**Contribution to Project:** *Data collection - Abstracts data from casualty records.*

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

Maj Patrick Ng, the active duty PI separated from the Air Force and Dr. Shelia Savell has assumed the role of PI.

**What other organizations were involved as partners?**

Nothing to report.

**8. SPECIAL REPORTING REQUIREMENTS****COLLABORATIVE AWARDS:** *N/A***QUAD CHARTS:** *N/A***9. APPENDICES:** *N/A*