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AWARD NUMBER: W81XWH-15-2-0085

TITLE: Evaluation of Role 2 (R2) Medical Resources in the Afghanistan Combat Theater: Past, Present and Future

PRINCIPAL INVESTIGATOR:

LTC Christopher VanFosson, PhD, RN

CONTRACTING ORGANIZATION: The Geneva Foundation
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PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

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6. AUTHOR(S) COL (ret.) Elizabeth Mann-Salinas, PhD, RN (through 30 November 2018); LTC Christopher VanFosson, PhD, RN (effective 01 December 2018) E-Mail: elizabeth.a.mannsalinas.ctr@mail.mil, christopher.a.vanfosson.mil@mail.mil		**5d. PROJECT NUMBER** **5e. TASK NUMBER** **5f. WORK UNIT NUMBER**
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13. SUPPLEMENTARY NOTES

14. ABSTRACT

Study Design: This observational study will be devoted to the analysis of existing (retrospective) data extracted from the Joint Trauma System (JTS) Role 2 Registry (Aim1). A comprehensive inventory and description of current R2 pre-deployment training programs and individual experiences will be conducted, an evidence-based program will be created and implemented to optimize provider performance of combat casualty care.

Objective: Describe and understand impact of R2 utilization during OEF and beyond, with emphasis on patient outcomes and provider competency.

Specific Aim 1 – Descriptive study of all available information for combat casualties in Afghanistan.

Specific Aim 2 – Identify the ideal provider training and competency assessment, sustainment and evaluation for medical staff deployed to R2 environment.

15. SUBJECT TERMS
Role 2 (R2), Role 3 (R3), Combat Casualty Care (C3/CCC), Department of Defense Trauma Registry (DoDTR), Operation Enduring Freedom (OEF)

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
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TABLE OF CONTENTS

1. INTRODUCTION:

There exists a continued lack of evidence about the impact of Role 2 medical resources in the combat theater. Although a Role 2 database has been in place since 2008, no systematic evaluation for these data has been conducted. Without analysis of this information, military planners and medical leaders will be unable to best allocate Role 2 resources in future operations. Furthermore, the clinical competencies required for each medical team member to function optimally in this environment have yet to be clearly defined or systematically supported across the Tri-Services.

2. KEYWORDS:

Role 2 (R2)
Role 3 (R3)
Combat Casualty Care (C3/CCC)
Department of Defense Trauma Registry (DoDTR)
Operation Enduring Freedom (OEF)

3. ACCOMPLISHMENTS:

What were the major goals of the project?

CY19 Goal - Evaluate long term outcomes of patients treated at R2 facilities. Post-performance assessment dashboard and standardized competency implementation.

What was accomplished under these goals?

All study progress and accomplishments are directly aligned with the SOW deliverables below.

Specific Aim 1 - Initiate R2 Registry (R2R) analysis and conduct comprehensive review of training literature, individual experiences, and Tri-Service training resources.

Subtask 1: Submit documents for HRPO approval.

Protocols and amendments have been submitted for HRPO review/approval.

(a) Human Use Regulatory Protocols

1. H-15-010 "Evaluation of Role 2 (R2) Medical Resources in the Afghanistan Combat Theater: Past, Present and Future" **Amendment #10**
   - Human Research Protection Officer (HRPO) assigned A-number: A-19116
   - Target number required/approved for clinical significance: 15,000
   - Type of submission: Local regulatory determination
   - Type of approval: Exempt local approval
   - PI: LTC Christopher VanFosson, PhD, MHA, RN
   - Status: Ongoing

2. H-16-009 "Analysis of Medical Interventions in the Combat Environment Related to Deployed Hospital Care" **Amendment #3**
   - HRPO assigned A-number: A-19116.3
   - Target number for clinical significance: N/A
   - Type of submission: Local regulatory determination
   - Type of approval: Exempt local approval
   - PI: LTC Christopher VanFosson, PhD, MHA, RN
   - Status: Ongoing

3. H-16-022 "Evaluation of Healthcare Systems Training for Combat Casualty Care Skills" **Amendment #3, Version #4**
   - HRPO assigned A-number: A-19116.2

- Target number for clinical significance: 150 surveys
- Type of submission: Local regulatory determination
- Type of approval: Exempt local approval
- Received DoD-wide Survey Approval
- PI: LTC Christopher VanFosson, PhD, MHA, RN
- Status: Ongoing

4. H-16-023 "The R2 Experience: Comparing the JTS R2 Registry and Surgeon Case Logs from 2008 to 2017" **Amendment #2**
   - HRPO assigned A-number: A-19116.5
   - Target number for clinical significance: N/A
   - Type of submission: Local regulatory determination
   - Type of approval: Exempt local approval
   - PI: LTC Christopher VanFosson, PhD, MHA, RN
   - Status: Ongoing

5. Old Dominion University "Evaluation of Role 2 (R2) Medical Resources in the Afghanistan Combat Theater: Past, Present and Future
   - HRPO assigned A-number: A-19116.7b
   - Target number for clinical significance: 150 subjects (all sites)
   - Type of submission: No greater than minimal risk
   - Type of approval: Expedited IRB Review
   - Status: Ongoing/anticipate closing soon

6. Old Dominion University "The Development of an Innovative Role 2 CPG-Based Trauma Knowledge-Assessment Instrument and Training Materials That Utilize Deliberative Practice and Mastery Training,"
   - HRPO assigned A-number: A-19116.7a
   - Target number for clinical significance: N/A
   - Type of submission: Local regulatory determination
   - Type of approval: IRB
   - Status: Ongoing/anticipate closing soon

7. H-17-014 NR "Tip-Top Pilot Study" (Evans Army Community Hospital)
   - HRPO assigned A-number: A-19116
   - Target number for clinical significance: N/A
   - Type of submission: Local regulatory determination
   - Type of approval: Not human subjects research; local approval
   - PI Determination
   - Status: Completed as of September 2019

8. H-18-001 "A Comprehensive Evaluation of Patients Treated at Role 2 Surgical Units in Afghanistan" **Amendment #2, Version #3, dated 11 February 2019**
   - HRPO assigned A-number: IRB Office No. M-10723
   - Target number for clinical significance: N/A
   - Type of submission: Expedited IRB Review
   - Type of approval: IRB Approved, minimal risk, expedited research
   - PI: LTC Christopher VanFosson, PhD, MHA, RN
   - Status: Ongoing

9. **2018-03 DODMWDVS Protocol:** "A Retrospective Review of U.S. Military Working Dogs Treated by Role 2 Surgical Teams in Afghanistan", PI: Jennifer Trevino, MBA
   - HRPO assigned A-number: NA
   - Target number for clinical significance: N/A
   - Type of submission: Animal Use Exempt Protocol
   - Type of approval: IACUC Approved
   - Status: Ongoing

10. PI-16-002 "Redefining and Restoring the USAISR Preceptorship Program"
   - HRPO assigned A-number: NA
   - Target number for clinical significance: N/A
   - Type of submission: Local regulatory determination
   - Type of approval: Exempt local approval
   - Status: Ongoing

Subtask 2: Identify sources and initiate process to obtain data other than R2R.
The following data sources were identified: Joint Trauma Systems; DoDTR; Role 2 Database; Golden Hour Database (TACEVAC, DoDTR, and AFME); TACEVAC Registry; United Kingdom Joint Theater Trauma Registry; Unit specific databases: 59th Medical Wing Aeromedical (AE) and Critical Care Air Transport Team (CCATT) database; 160th SOAR Para-rescue Team registry. Additionally, a unique Iraq dataset from July 2015-2016 from LTC Christina Hahn with n=314 Iraqi trauma patients was identified and the manuscript was published. As the team identifies new data sources, research in this area will be ongoing.

Subtask 3: Describe all data available in R2R, conduct gap analysis.
All data available for OEF in the Role 2 dataset were described in the manuscript entitled "Evaluation of Role 2 (R2) medical resources in the Afghanistan combat theater: initial review of the joint trauma system Role 2 registry". Dozens of subsequent analyses have been conducted on unique elements of the database. Refer to manuscripts and other dissemination products for these analyses. Topics include, but are not limited to: analysis of the Case Fatality Rates/Died of Wounds for OIF/OEF compared to Vietnam, transport from point of injury to Role 2, transport from R2 to R3, analysis of time at R2, patients treated in 2016 at a R2 in Iraq, pediatric patients treated at R2, use of blood (components and fresh whole blood, analgesia provided prior to R2), airway adjuncts prior to R2, all patients who died, orthopedic/ocular injuries and interventions, development of a surrogate injury severity score (Combat Mortality index) due to lack of ISS in dataset, traumatic brain injury, emergent resuscitative thoracotomy, and initial evaluation of R3 outcomes and ICU patients.

The research team continues to publish manuscripts to disseminate our research findings. The 'Procedural burden' manuscript was recently published during this reporting period. Additionally, the research team recently completed the pre-deployment training survey manuscript and plans to submit this paper before the end of the year. The research team will continue working on other dissemination efforts. Ongoing deliverable.

Subtask 4: Compile and analyze all "lessons learned" regarding R2 operations during OEF/OIF.
Findings from Role 2 manuscripts compiled, analyzed, and described the lessons learned regarding Role 2 operations. Army Centers for Lessons Learned is an active partner in this project to record identified lessons learned as analyses continue. The Joint Trauma Systems, now part of the DHA, also focuses on process improvements and "lessons learned" for trauma and combat casualties. The research team continues works alongside the Joint Trauma system (via data sharing agreement) regarding further clarification and understanding of how we can improve the missing data in the DoDTR. The research team helped identify gaps in the current data variables within the DoDTR and data collection processes required for enhanced future analysis. Ongoing deliverable.

Subtask 5: Describe all training assets available for R2 team members.

In collaboration with IVIR, Inc., the research team completed several activities to understand all military and civilian available pre-deployment training assets. Collaborative activities included observational trips to training locations, literature searches, and discussions/meetings with subject matter experts. These comprehensive findings were described in the “MATRIX”. A literature review concerning the elements of Role 2 training and combat casualty care readiness included assessment parameters relative to proficiency, competency, and mastery models.

The information was previously provided to the Defense Medical Readiness Training Institute Director, Col Michael Charlton in 2017 to support the development of a joint pre-deployment curriculum and course. This effort to develop a joint course was directed by the Education and Training Subcommittee of the Committee of Surgical Combat Casualty Care, funded by JPC-6 (PI: Shackelford). As a result of the collaboration with the Role 2 study, providing the results of the year-long compilation of the existing course information and literature review of best practice saved a redundant effort by DMRTI staff and expedited course development.

Subtask 6: Conduct survey of deployed R2 members for personal training experience, confidence upon deployment.

During this reporting period, the training survey results were presented at the 2019 TSNRP dissemination course and the manuscript has been finalized. We anticipate it will be submitted it to the MHSRS supplement before the end of the year.

The findings have been shared with Army Nurse Corps leadership to support current policy decision for improving nursing/medic deployment readiness. This is the largest survey of non-physician pre-deployment training to date.

As a result of this study, and our efforts and accomplishments with the training survey, the research team recently started collaborate with the JTS performance improvement team on a medic AAR project to understand the medic equipment/TCCC training evaluation. The medic AAR project is directly related to subtask 6 and will allow us to do a deeper dive into the medic feedback we already collected through the survey.

Subtask 7: Based on literature review, recommend best practice for R2 training.

The literature review was completed and identified general education barriers to training that related to combat casualty care. Three generic categories were identified; situational, institutional, and dispositional. In the study certain populations were more likely to face barriers than others: these barriers will be applied to the gap analysis, and “training breeds training” suggesting that training creates a perception for the need of more training. The literature review and updates were included within the literature traceability matrix. We’ve continued to reference the results and lessons learned from literature traceability matrix.

Additionally, these principles of optimizing training are being applied to a parallel effort funded by the Army RAD 2 program through the task area. A pilot program for pre-deployment readiness training was implemented at the Army Burn Center and the BAMC Level 1 Trauma Center in 2018.

Specific Aim 2 – Develop R2R Performance Assessment Dashboard.

Subtask 1: Create metrics to evaluate R2 outcomes and team performance
& Subtask 3: Track training and sustainment programs for R2 members.

During this reporting period, the research team continued to collaborate with the USAISR Burn Center pre-deployment training program to evaluate performance, and track and train pre-deployers. The training provided included both didactic and clinical exposure, using the universal CCC tools. As a result of the program update, the appropriate data is being collected, allowing the ability to develop a clinical dashboard prototype. Ongoing deliverable.

Subtask 2: Develop DoDTR report for near-real time feedback to deployed teams.
In concert with JTS, this deliverable will ultimately be met as The Medical Situation Awareness Tool (MSAT) used within CENTCOM provides medical and logistical awareness for combat casualties in the AO. The existing MSAT is approximately an 80% solution for this deliverable. The DoDTR and MSAT are unable to track providers, provide training, and determine geospatial awareness of medical assets and patient flow. Within the JTS, process improvement recommendations are currently underway to improve real-time situational awareness of medical assets deployed world-wide and track all patient movement and outcomes.

Specific Aim 3– Expand R2 database to all deployed units to OEF/OIF.

Subtask 1: Obtain all identified data other than R2R.
The research team recently received identifiable data during this reporting period (see IRB approved protocol H-18-001) and will continue to expand the R2 dataset as needed. Ongoing deliverable.

Subtask 2: Create repository within DoDTR for these data.
The DoDTR has been merged with the Role 2 database, therefore, this deliverable has been completed. However, the Role 2 dataset obtained for this proposal continues to be a more complete dataset. Continued collaboration with JTS to make this research dataset available to investigators are ongoing.

Subtask 3: Conduct analysis and contrast by R2 unit and phase of conflict (entry, surge, and sustainment).
The research team is comparing and contrasting the Role 2 units 'by year', rather than by the 'phase of conflict' utilizing the recently acquired dataset (protocol H-18-001). The research team plans to include this table in a future publication during the next calendar year. Ongoing deliverable.

Specific Aim 4 - Implement TriService training and sustainment standard.

Subtask 1: Cross-walk all training programs for R2 team members.
In collaboration with IVIR, Inc., the cross-walk of all training programs for Role 2 team members has been completed. Eleven relevant categories were identified for the training program traceability MATRIX, to include: general course information, course details, course content, instructional methodologies, course type, course availability, assessment criteria, requirements, funding, alignment with clinical practice guidelines, and alignment with tactical combat casualty care. From these 11 parent categories, subcategories were then generated to capture the appropriate data elements of interest; 40 independent subcategories were identified. Training program research and traceability matrix were requested by and provided to the Committee for Surgery in Combat Casualty Care; Committee for Tactical Combat Casualty Care; Defense Medical Readiness Training Institute; Knowledge, Skills and Attributes Working Group, and the Army Trauma Training Detachment.

Subtask 2: Develop and validate knowledge assessment tool for combat-related skills.
Collaborations between VNIP, Old Dominion University, and the research team are ongoing. ODU is working towards finalizing and validating the knowledge assessment tool for combat-related skills. As provided by ODU, the Knowledge Acquisition and Testing System (KATS) provides a platform that supports all types of educational materials on the topic of military trauma patient management content based on the concepts and content from the Clinical Practice Guidelines (CPGs) developed by subject matter expert teams who used data from the Joint Theater Trauma Registry (JTTR) to develop evidence-based guidelines for care. KATS is comprised of a testing or assessment capability to assess the level of core trauma knowledge. This first release of KATS focuses on nursing care. Surgeon and physician knowledge tests are being developed by CAPT Elster's KSA team, in concert with the American College of Surgeons. The primary goal of this study is to validate the Knowledge Acquisition & Testing System (KATS) as a reliable and valid instrument to use for testing the level of military trauma knowledge for DOD clinicians based on the JTS data-driven CPGs and consensus KSAs. During the reporting periods, ODU collaborators provided the research team with a platform

to trial the knowledge assessment tool. The team anticipates receiving the results from this study. Ongoing deliverable.

Subtask 3: Generate universal combat casualty skills for each provider type.
In collaboration with ODU and VNIP, the research team generated the universal combat casualty care skills for non-physician clinicians based on the Army Burn Center TIP-TOP program (Transition in Practice Towards Optimal Performance staff development program based on VNIP). These collaborations resulted in the development of a program support document (guide book and reference/workbook) that provides content explanation, demonstration, and a great source for additional reference material). The materials are all aligned with the KSA domains. Physician knowledge, skills, and surgical ability is being defined and developed by the KSA project group as mentioned previously. In support of this deliverable, a performance improvement project was completed to define the core components of a nurse competency program using a Delphi approach (i.e., expert opinions). As a result, the findings were published in the Delphi manuscript during this reporting period.

Subtask 4: Develop and implement metrics for evaluating skill and knowledge retention.
Completed Deliverable - The KSA group has been heavily focused on physician skill and metrics, therefore our project has been focused on filling the gap by focusing on RN, LVN, and Techs. The research team developed a paper-based competency assessment tools (CATs) for RN, LVN, and Techs to track skills and knowledge related to combat casualty care for nurses and medics. Using the retrospective Role 2 data analysis and the TIP-TOP/VNIP framework, the research team identified realistic, clear, and concise performance objectives applicable to the CAT for realistic patient scenarios. The CAT cross-walk accounted for Army, Navy, and Air Force pre-deployment competency standards for Tri-service applicability. Since the last reporting period, the Austere Care Tool has been updated to include en route care competencies. This tool has been renamed to "Expeditionary Care Tool". The information is in the process of becoming automated through the US Army Burn Center Pre-deployment Program.

Specific Aim 5 - Implement TIP-TOP Pilot study at a military treatment facility (MTF).

Subtask 1: Determine the number of preceptors and nurse trainees.
Completed Deliverable - Research Nurse Coordinator at Evans Army Community Hospital Education conducted monthly preceptor training sessions. These sessions were aimed at training both preceptors and hospital staff members to help socialize the TIP-TOP concepts, principles, and documentation. During this pilot period, 132 staff members attended training.

Hospital Unit/Clinic	RN	LPN/LVN	Other/ Unknown	Grand Total
Primary Care Clinic	11	5	6	22
Medical-Surgical	13	3	2	18
Mother Baby	13	0	0	13
Intensive Care	10	0	1	11
Emergency Department	10	0	0	10
Surgical Services	8	1	1	10
Inpatient Behavior Health	3	5	0	8
Labor and Delivery	8	0	0	8
Pediatics Care	3	1	4	8
OB/GYN Clinic	0	2	3	5
Cardiology	3	0	0	3
Education	1	2	0	3
Gastrointestinal	2	1	0	3

Internal Medicine	2	1	0	3
Unknown	0	3	0	3
Float	2	0	0	2
Rehab Clinic	0	1	0	1
Urology Clinic	1	0	0	1
Grand Total	90	25	17	132

Subtask 2: Identify and train 100% current nursing preceptors (n = x preceptors) on TIP-TOP.
A 115 RN and LVN/LPN preceptors were trained hospital wide. Of these 47 were within the four target units most associated with combat casualty care (Medical Surgical, Emergency Department, Intensive Care Unit, and Surgical Services). After accounting for attrition (n=19), 28 trained preceptors remain within the target units (11 Medical Surgical, 5 Emergency Department, 6 Intensive Care Unit, and 6 Surgical Services) and 19 untrained preceptors remain; approximately 60% trained.

Subtask 3: Identify and orient all new nurses on TIP-TOP (n = x nurse trainees).
From October 2018 to September 2019 there were 24 new staff nurses that transitioned into the target units (11 Medical-Surgical, 5 Emergency, 4 Intensive Care Unit, and 4 Surgical Services). Approximately 29% (n=7) were transitioned by a trained preceptor on TIP-TOP. Due to leadership turnover and high preceptor turnover (n=19), full implementation was limited. Even with limited implementation a total of 27 weeks of training was saved by transitioning to competency versus transitioning for a set amount of time. In addition, 2 new hire were identified as needing additional time to transition and were provided extra training.

Subtask 4: Collect data/outcome measures on completeness of the employee CAF folder, duration of preceptorship, and variation in competency.
Completed deliverable – Previously audited CAF folders. Findings included documentation and administrative issues (i.e., use of rubber stamps, missing dates and names, etc.). Training and guidance was provided to staff members. For units not using universal CBOs and PETs consistently, leadership was notified. Documentation issues were noted during initial audit prior to the start of this study. Despite reduced documentation requirements, increased training, and increased ease of use with CBO and PETs, staff continues to document in the same manner.

Subtask 5: Perform data analysis to evaluate critical thinking, reduce documentation burden, increase the accuracy and completeness of competency documentation, and provide a method to effectively track competency progression.
Due to this limitation, documentation has been limited and we are unable to evaluate data for competency progression. The RN Nurse Coordinator followed up with units to implement process, however, preceptors reported lack of leadership support for requests for administrative time to document competencies and formally provide feedback. During the pilot period, the education chief has changed 4 times and the Medical/Surgical, Emergency Department, and Intensive Care Unit have all experienced at least one NCOIC change. Unit preceptors have found it challenging to document competency appropriately without the allocation of administrative time. PI closed out/completed study at EACH during this reporting period, effective September 2019.

Subtask 6: Trouble shoot issues with implementing the transition program or process.
Since initiating the TIP-TOP Pilot study at EACH, the PI and RN research coordinator have experienced significant challenges with implanting the TIP-TOP pilot at EACH. Several leaders have transitioned in/out of this facility; therefore, leadership and staff engagement has been an ongoing issue. The research team has provided their best efforts to sustain this study at EACH, however, this study is no longer receiving the support required for sustainability at this site. PI closed out/completed study at EACH during this reporting period, effective September 2019.

Milestone: Provide lessons learned on TIP-TOP to standardize and improve nurses transitioning into specialty practice, and to provide a method to effectively track competency progression.
PI closed out/completed study at EACH during this reporting period, effective September 2019. Coordinator at EACH provided leadership and staff with at transition plan for long-term sustainment and/or implementation, if desired. Coordinator created a PowerPoint presentation and uploaded to EACH intranet for reference. This milestone has been accomplished.

Specific Aim 6 – Evaluate long term outcomes of patients treated at R2 facilities post Performance Assessment Dashboard and Standardized Competency implementation.

Subtask 1: Compare outcomes for patients treated at Role 2 after implementation of standardized pre-deployment training program.

What opportunities for training and professional development has the project provided?
PIs, LTC VanFosson, and COL (Ret.) Mann-Salinas continued to support the research team with mentorship and professional development opportunities, including the following:

- Epidemiologist, Amanda Staudt, PhD continues to work one-on-one with executive/senior level statisticians/epidemiologists across the USAISR and the Department of Defense (DOD). In addition, Dr. Staudt presented the teams research findings locally, and at a national conference, which has contributed to her ongoing professional development.
- Program Manager, Jennifer Trevino, MBA attended The University of Texas at San Antonio Lean Six Sigma Yellow Belt certification course, the BAMC A3 Course, and qualified to take the Project Management Institute Project Management Professional Certification course for ongoing professional development. Ms. Trevino continues to consult with, and collaborate with colleagues and leaders across the institute and DoD.
- Research Nurse Coordinator, Krystal Valdez-Delgado, BSN, RN worked closely with other senior level nurse educators across the DoD and Tri-services and received one-on-one mentorship and training in nursing education and training for ongoing professional development.

As a result, the research team contributed to, and/or attended and presented at the following conferences or events:

- 2019 Tri-Service Nursing Research Symposium in San Diego, CA
- 2019 Military Health Systems Research Symposium in Kissimmee, FL
- 2019 BAMC Nurses Week in San Antonio, TX
- 2019 5th Annual San Antonio Military Health System and Universities Research Forum
- 2019 Scientific Seminar at USAISR in San Antonio, TX
- 2019 American Association of Blood Banks (AABB)
- 2019 Southern Region Burn Conference
- 2019 Army Nurse Corp Association

How were the results disseminated to communities of interest?
In addition to presenting our new and ongoing research findings at national and local research conferences, our significant progress has resulted in numerous manuscript publications and ongoing collaborations with members of the community (see section 6 below).

What do you plan to do during the next reporting period to accomplish the goals?
CY19 Goals – Evaluate long term outcomes of patients treated at Role 2 facilities using pending complete dataset from DoDTR with patient identifiers. PI plans to submit no cost extension to continue working on these deliverables.

Collaborate with the Joint Trauma System on a medic equipment/TCCC training evaluation project related to R2.

Continue to disseminate research findings through manuscript publications including the following:

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: Nothing to report.

6. PRODUCTS:

Publications, conference papers, and presentations

Presentations:

- 2019 USAISR Scientific Seminar
- 2019 TSNRP - Evaluation of Pre-deployment Training for Army Nurses and Medics
- 2019 AABB - Improving strategies for life-saving blood transfusion in military casualties: What, when and how
- 2019 MHSRS – A seven year study of casualty injury patters and procedural burden experienced by U.S. military Role 2 forward surgical teams in Afghanistan

Posters:

- 2019 TSNRP - Evaluation of Pre-deployment Training for Army Nurses and Medics
- 2019 MHSRS - Analysis of Far Forward Ocular Trauma among Combat Casualties in Afghanistan
- 2019 MHSRS - Combat Casualty Care Readiness Achieved Following Level 1 Trauma/Burn Clinical Exposure Training
- 2019 MHSRS – A Review of Casualties that underwent pain management before reaching a Role 2 in Afghanistan
- 2019 SURF - An Assessment of Pre-deployment Training of Army Nurses and Medics
- 2019 BAMC Nurses Week - An Assessment of Pre-deployment Training of Army Nurses and Medics
- 2019 Southern Region Burn Conference - Development of a Standardized Competency Program for Combat Medical Readiness
- 2019 Army Nurse Corp Association - Development of a Standardized Competency Program for Combat Medical Readiness

Journal publications. All publications include the acknowledgement of federal support

1. Hahn, C., Staudt, et al. (2019). "Characteristics of Iraqi Patients Treated During Operation Inherent Resolve by a Forward Surgical Team." Military medicine 184(Supplement_1): 301-305.

2. Boyer, S., Mann-Salinas, et al. (2019). "Using the Delphi Technique to Determine Core Components of a Nurse Competency Program." Journal for nurses in professional development 35(5): 261-267.
3. Forward Surgical Team Procedural Burden and Non-Operative Interventions by the U.S. Military Trauma System in Afghanistan, 2008-2014 (accepted to Military Medicine MILMED-D-19-00516R1)
4. A Review of Casualties that Underwent Airway Management before Reaching Role 2 in Afghanistan (accepted to Military Medicine MILMED-D-19-00178R3)
5. Association of Early Mortality with the Inclusion of Fresh Whole Blood in the Resuscitation of Combat Casualties (resubmission to JoT)

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
Educational aids/curricula:

- Implementation of Tip-Top PowerPoint Presentation

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

- LTC Christopher VanFosson
- COL (Ret.) Elizabeth Mann-Salinas
- Amanda Staudt, PhD
- Jennifer Trevino, MBA
- Krystal Valdez-Delgado, BSN, RN
- COL Jennifer Gurney, MD
- Mithun Suresh, MD
- COL (Ret.) Russ Kotwal, MD
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- Rory Rickard
- Kyle Remick
- John Oh
- David Cannon
- Avi Benov
- Jacob Chen
- Ariel Furer
- Matt Borgman
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- Jessica Rivera
- Daniel Stinner
- James Blair
- Joseph Wenke
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Name: Deborah del Junco
Project Role:
Researcher Identifier: NA
Nearest person month worked: 3
Contribution to project: Mentor for statistical support
Funding Support: NA

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: N/A

QUAD CHARTS: Attached.

9. APPENDICES: Attached copies of final manuscripts (2), presentations (4), posters (8), and education aids/curricula (1).

Improving strategies for life-saving blood transfusion in military casualties: *What, when and how*

12 October 2018

Jennifer Gurney, MD FACS
COL, MC, USA

AABB-THOR Joint Working Group Hemorrhagic Shock Resuscitation Workshop


RIGHT PATIENT
RIGHT PLACE
RIGHT TIME
RIGHT CARE
JOINT
TRAUMA SYSTEM


UNITED STATES ARMY
INSTITUTE OF SURGICAL RESEARCH


TRAUMA HEMOSTASIS & OXYGENATION RESEARCH
THOR


DEFENSE HEALTH AGENCY
PRO CURA MILITIS
DEPARTMENT OF DEFENSE


DHA

Disclaimer

- The opinions or assertions contained herein are the private views of the author and not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

- There are no conflicts of interest to disclose.

Pre-hospital Transfusion (PHT) Background

The existing literature offers…

1. **Conflicting findings**
2. **Poor quality evidence**

SHOCK, Vol. 46, No. 1, pp. 3–16, 2016

OPEN

Review Article

PREHOSPITAL BLOOD PRODUCT RESUSCITATION FOR TRAUMA: A SYSTEMATIC REVIEW

Iain M. Smith,[*†‡] Robert H. James,[§‖¶] Janine Dretzke,[***] and Mark J. Midwinter[*†]

- 37 unique studies identified, 1 prospective, 0 RCTs, 10 excluded for ambiguities
- Significant heterogeneity precluded a valid summary relative risk (RR) from meta-analysis
- 25/27 studies rated very low quality
- **No survival benefit identified**

Three Major Methodologic Flaws

noted in systematic review by Smith et al

1. **Study groups <u>not</u> equivalent, bias/confounding**
   a. Indications for PHT (bleeding severity)
   b. Interventions other than PHT (pre-post designs)
   c. Time (from injury to start of PHT, post-PHT survival time)
   d. Misclassification of PHT (transported from scene vs. transferred)

2. **Sample sizes too small, too few patients at high risk of hemorrhage-related mortality**

3. **Key data often missing**

Our MEDEVAC PHT Study
Methods

Designed to overcome flaws in previous studies:

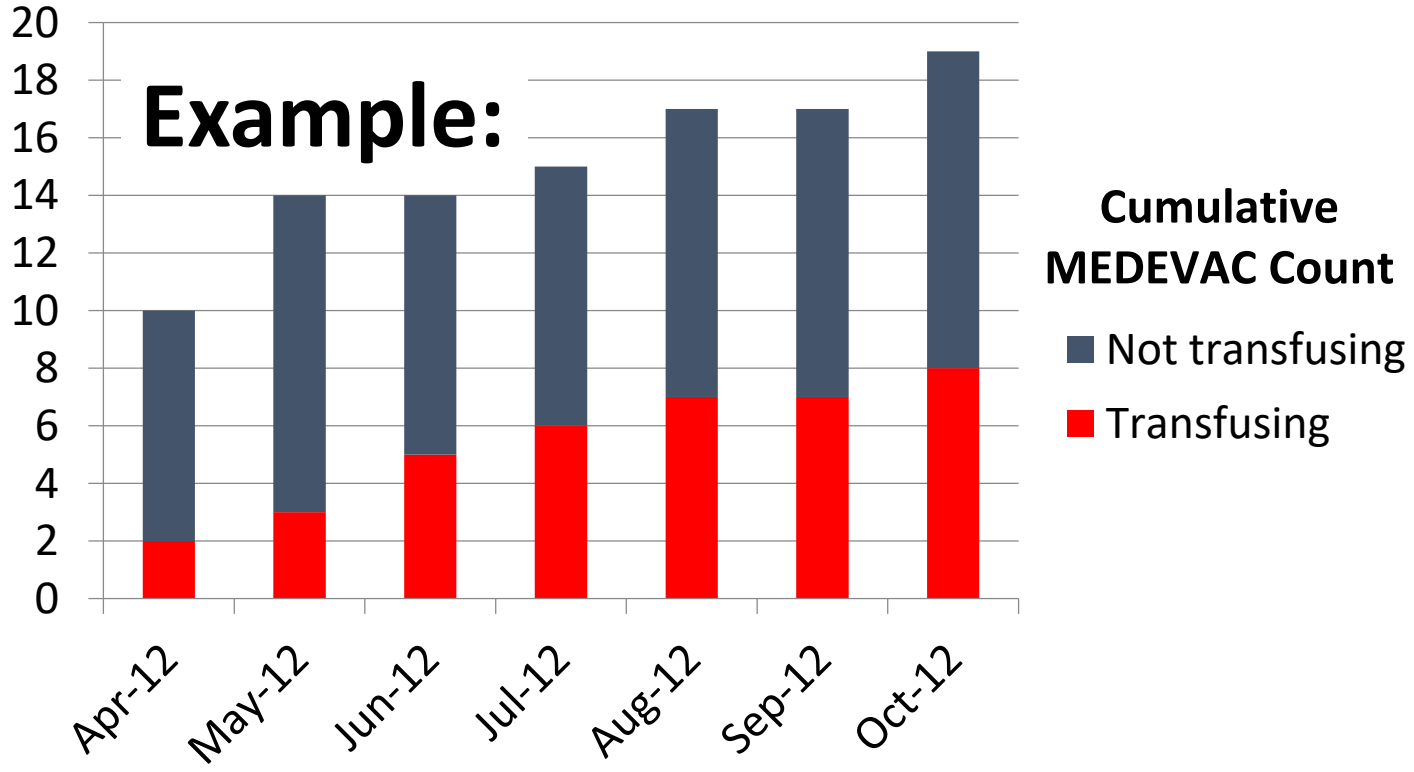
- ✓ Minimized bias & confounding
- ✓ Assembled a large sample of high-risk patients
- ✓ Tracked down missing data

Approved as an Exempt Performance Improvement Initiative by the DoD Joint Trauma System

Study Population: US military casualties in Afghanistan from April 1, 2012 to August 7, 2015

Study Design: Retrospective comparing concurrent cohorts

Gradual expansion of transfusion capability to different MEDEVACs



MEDEVAC PHT Study Data Resources

- DoD Trauma Registry
- Pre-hospital Database
- Hospital Records
- Armed Forces Medical Examiner
- Original paper-based records

MEDEVAC PHT Retrospective Study Flow Diagram

502 potential study candidates met 3 criteria:

1) U.S. military casualty in Afghanistan April 1, 2012 - August 7, 2015
2) Evacuated alive from the point of injury by MEDEVAC helicopter
3) Documented one of the established indications for PHT:
   a) Multiple traumatic amputations, at least one above knee or elbow
   b) Pre-hospital heart rate >120 beats/minute or systolic blood pressure <90 mmHg

55 PHT recipients were stratified based on 5 factors:

1) Mechanism of injury (gunshot vs. explosion)
2) Positive indicator of hemorrhagic shock (Yes/No)
3) Traumatic limb amputations
   a) 0=none
   b) 1=1 below knee/elbow
   c) 2=2 or more below knee/elbow or 1 above knee/elbow but below hip
   d) 3=2 or more above knee/elbow
4) Maximum severity of head injury by Abbreviated Injury Severity (AIS) score (0-1 vs. 2 vs. ≥3)
5) Significant torso hemorrhage by AIS score (Yes/No)

447 non-recipients were group-matched to recipients

=

345 matching non-recipients

102 unmatched non-recipients.

MEDEVAC PHT Study

Results

Primary Hypothesis:

Pre-hospital transfusion is associated with improved survival from hemorrhagic shock.

MEDEVAC PHT Study
Unadjusted Mortality Differences

Mortality Follow-up Period	PHT-Recipients (n=55)	All non-recipients (n=447)	Unadjusted *P* values	Matched non-recipients (n=345)	Unadjusted *P* values
Death within 24 hours of MEDEVAC rescue (%)	3 (5%)	85 (19%)	0.013*	69 (20%)	0.007*
Death within 30 days of MEDEVAC rescue (%)	6 (11%)	102 (23%)	0.043*	78 (23%)	0.050

Because the PHT capability of non-recipients' transport teams was undocumented,

we chose matching factors and other covariates that transport teams likely observed

to better balance the two study groups

and statistically adjust our survival analyses.

MEDEVAC PHT Study: Group-Matching Factors

Injury Characteristics	PHT-Recipients (n=55)	All non-recipients (n=447)	Unadjusted *P* values	Matched non-recipients (n=345)	Unadjusted *P* values
Mechanism of Injury			0.029*		0.051
Gunshot Wound (%)	9 (16%)	119 (26%)	-	101 (29%)	-
Explosives (%)	46 (84%)	303 (68%)	-	244 (71%)	-
Other (motor vehicle crash, falls, etc.) (%)	0 (0%)	25 (6%)	-	0 (0%)	-
Documented Pre-hospital Shock (SBP<90, HR>120, shock index >0.9) (%)	51 (93%)	405 (91%)	0.805	330 (96%)	0.313
Traumatic Limb Amputations			<0.0001*		<0.0001*
None (%)	15 (27%)	331 (74%)	-	251 (73%)	-
1 below knee/elbow (%)	12 (22%)	48 (11%)	-	38 (11%)	-
Bilateral, >1 below knee/elbow, or 1 above but below hip/shoulder (%)	12 (22%)	38 (8%)	-	31 (9%)	-
Bilateral or > 1 above knee/elbow (%)	16 (29%)	30 (7%)	-	25 (7%)	-
Significant Torso Hemorrhage by AIS Diagnostic Code (%)	31 (56%)	164 (37%)	0.005*	122 (35%)	0.004*
Maximum AIS Score for Head Injury Severity			0.602		0.620
0-1 (%)	26 (47%)	185 (41%)	-	163 (47%)	-
2 (%)	18 (33%)	176 (39%)	-	129 (37%)	-
≥3 (%)	11 (20%)	86 (19%)	-	53 (15%)	-

MEDEVAC PHT Study

Additional covariates adjusted along with matching factors in Cox proportional hazards survival analysis

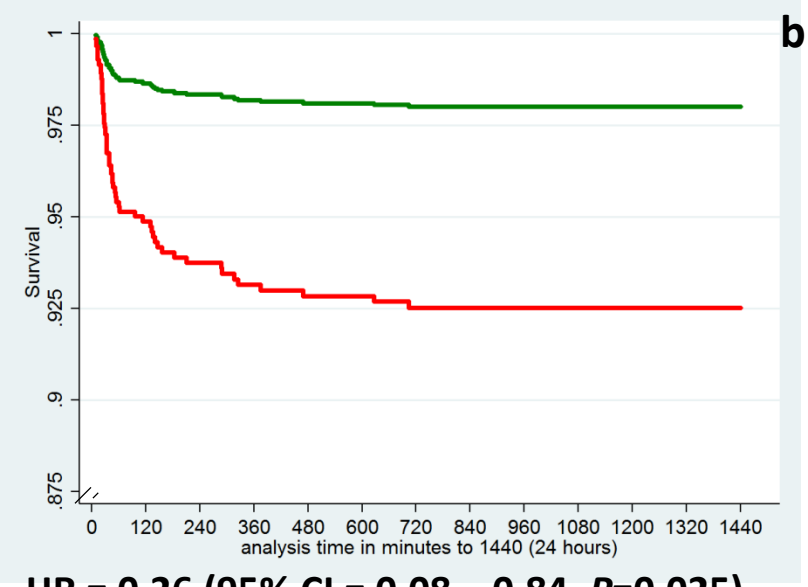
- Age
- Injury year
- Transport team's level of care
- Pre-hospital tourniquet used
- Minutes from injury occurrence to MEDEVAC rescue

We used the delayed entry approach to appropriately adjust for immortal time bias given recipients had to survive long enough for PHT to be initiated after MEDEVAC rescue.

Adjusted Cox Proportional Hazards Models

24 hour survival

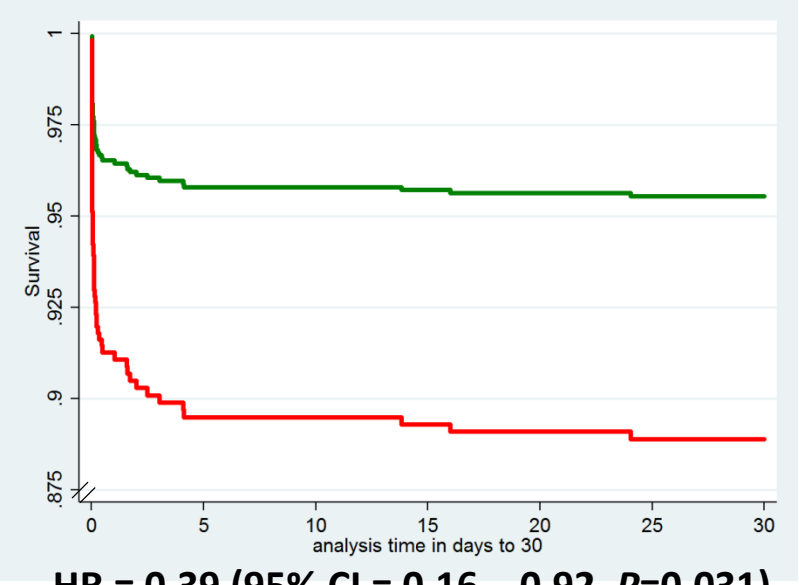
a.



HR = 0.26 (95% CI = 0.08 – 0.84, *P*=0.025)

30 day survival

b.



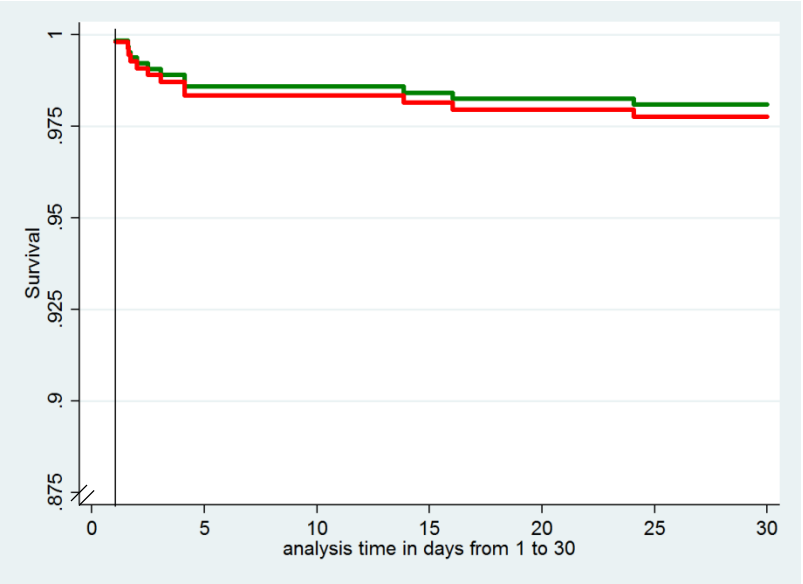
HR = 0.39 (95% CI = 0.16 – 0.92, *P*=0.031)

PHT recipients

Non-recipients

Conditional 30-day survival among 24-hour survivors

c.



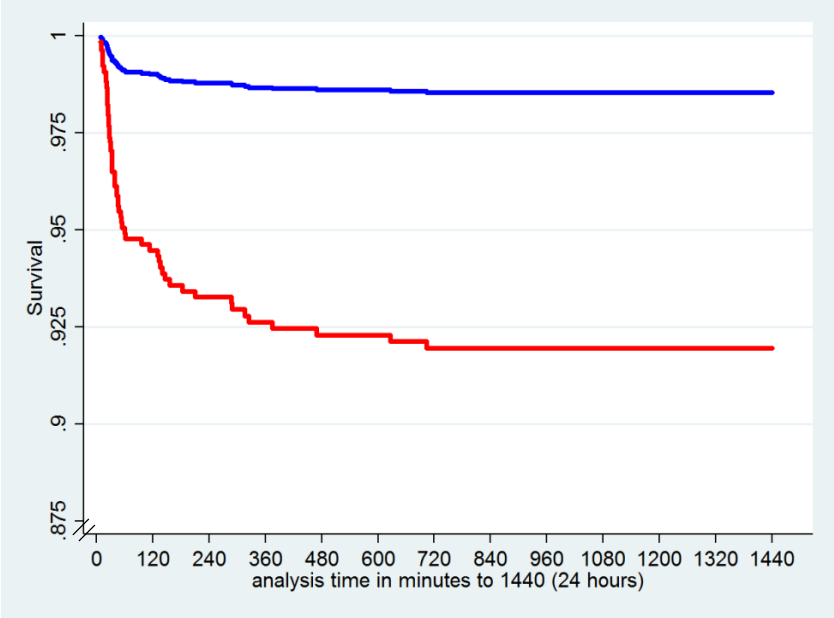
HR = 0.84 (95% CI = 0.18 – 4.00, *P*=0.831)

Early Transfusion, Pre- or In-Hospital

Adjusted Cox Proportional Hazards Models for 24 hour Survival

Transfusion within 15 minutes vs. longer delays after MEDEVAC rescue from point of injury

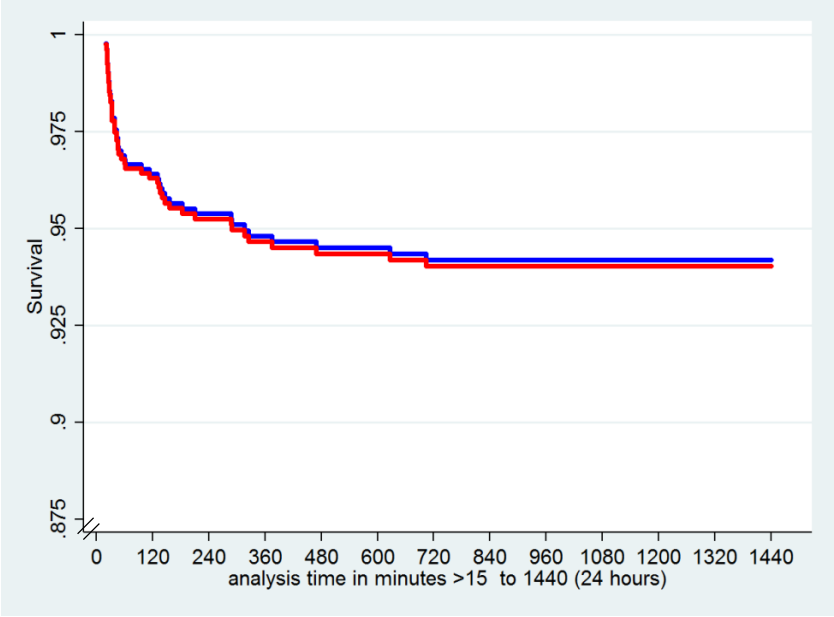
a.



HR = 0.17 (95% CI = 0.04 – 0.73, *P*=0.017)

Conditional survival among 16-minute survivors: Transfusion within 16-20 minutes vs. longer delays

b.



HR = 0.94 (95% CI = 0.41 – 2.17, *P*=0.887)

Earlier transfusion

Delayed transfusion

Post-treatment characteristics and secondary outcomes - Unadjusted

Post-treatment Characteristics and Outcomes	PHT-Recipients (n=55)	Non-Recipients (n=345)	Unadjusted P values
Injury Severity Score (ISS): Median (IQR)	29 (17, 36)	17 (9, 33)	0.001*
Maximum AIS Score: Median (IQR)	4 (3, 5)	3 (2,5)	<0.0001*
Received Tranexamic Acid [TXA] (%)	48 (87%)	122 (35%)	<0.0001*
MEDEVAC transport time in Minutes: Median (IQR)	17 (15, 22)	(n=333) 16 (12, 23)	0.771
Minutes from injury occurrence to arrival at 1st surgical hospital: Median (IQR)	(n=54) 47.5 (37, 59)	(n=334) 45 (33, 60)	0.660
1st Surgical Hospital Level of Care Role 3 theater hospital vs. Role 2 resuscitative care (%)	48 (87%)	(n=304)† 164 (54%)	<0.0001
Documented shock (SBP<90, HR>120 or shock index >0.9) upon ED arrival (%)	42 (76%)	(n=299)† 162 (54%)	0.002*
ED base deficit: Median (IQR)	(n=52) -7 (-11, -4)	(n=249)† -3 (-7, -1)	<0.0001*
ED pH: Median (IQR)	(n=53) 7.28 (7.17, 7.38)	(n=257)† 7.36 (7.29, 7.42)	<0.003*
ED hemoglobin: Median (IQR)	(n=51) 12.4 (10.9, 13.7)	(n=261)† 14.3 (13.0, 15.3)	<0.0001*
ED INR: Median (IQR)	(n=34) 1.4 (1.2, 1.7)	(n=210)† 1.2 (1.0, 1.3)	0.006*
Total units of RBCs or whole blood within 24 hours of ED arrival: Median (IQR)	15 (8, 23)	(n=186)† 10 (4, 20)	0.001*
Total hospital days over the 30 days of follow-up among survivors at day 30 (IQR)‡	(n=48)‡ 30 (21, 30)	(n=265)‡ 18 (4, 30)	0.050

†Non-recipients who survived to the Emergency Department (ED) of the 1st surgical hospital (n=304)

‡Study patients who were discharged alive or survived at least through hospital day 30 (n=316, PHT-n=49, Non-Recipient-n=267)

Study Strengths

Capitalizing on unique and comprehensive research resources, this study was able to establish…

- At least a 4-fold sustained survival benefit from rapid transfusion (Number Needed to Treat $\leq$ 8).
- Timing is critical; benefit depends on starting transfusion within minutes of injury occurrence.
- Studies of advances in pre-hospital trauma care must include pre-hospital and early deaths.

Right Patient, Right Place, Right Time, Right Care

MEDEVAC PHT Study's Limitations

- A retrospective cohort design cannot overcome unmeasured, potentially important confounding (e.g., contra-indications for pre-hospital transfusion).

- Missing data values, especially for pre-hospital patient characteristics, diagnostic assessments, and intervention timing, remain a challenge.

MEDEVAC PHT Study

Conclusions…

our findings

1. **Support blood product transfusion as far forward as possible**
2. **May help resolve conflicting findings and inform the design of future studies**

TRANSITION FROM ‘WHEN’ TO WHAT

Questions

Background

J Trauma. 2006;60:S59–S69.

The Journal of TRAUMA® Injury, Infection, and Critical Care

The Use of Fresh Whole Blood in Massive Transfusion

Thomas B. Repine, MD, Jeremy G. Perkins, MD, David S. Kauvar, MD, and Lorne Blackborne, MD

Volume 60 • Number 6 S59

Conclusions: Under extreme and austere circumstances, the risk:benefit ratio of whole blood transfusion favors its use. Fresh whole blood may, at times, be advantageous even when conventional component therapy is available.

Background

Warm fresh whole blood transfusion for severe hemorrhage: U.S. military and potential civilian applications

Philip C. Spinella, MD

Objective: The objective of this study was to review the history and current literature regarding the benefits and risks of warm fresh whole blood transfusion to include recent U.S. Army research from Afghanistan and Iraq. We also discuss current indications for its use as well as potential civilian applications for large-scale disasters.

Background: The use of warm fresh whole blood currently only persists in emergency life-threatening scenarios when tested stored blood components are not available. Recent combat operations in Afghanistan and Iraq have redirected attention on the benefits and risks of warm fresh whole blood for life-threatening injuries in casualties.

Main Results: Between March 2003 and July 2007, over 6000 units of warm fresh whole blood have been transfused in Afghanistan and Iraq by U.S. medical providers to patients with life-threatening traumatic injuries with hemorrhage. Preliminary results in approximately 500 patients with massive transfusion indicate that the amount of fresh warm whole blood transfused is independently associated with improved 48-hr and 30-day survival and the amount of stored red blood cells is independently associated with decreased 48-hr and 30-day survival for patients with traumatic injuries that require massive transfusion. Risks of warm fresh whole blood transfusion include the transmission of infectious agents and the potential for microchimerism.

Conclusions: For patients with life-threatening hemorrhage at risk for massive transfusion, if complete component therapy is not available or not adequately correcting coagulopathy, the risk: benefit ratio of warm fresh whole blood transfusion favors its use. In addition, recent evidence suggests that there is potential for warm fresh whole blood to be more efficacious than stored component therapy that includes stored red blood cells in critically ill patients requiring massive transfusion. Efforts must continue to improve the safety of warm fresh whole blood transfusion for patients when it is required in emergency situations. U.S. civilian disaster agencies are preparing guidelines for its use in massive casualty scenarios and prospective, randomized trials are about to start to determine whether stored warm fresh (<24 hrs) whole blood improves outcomes compared with standard stored component therapy. (Crit Care Med 2008; 36[Suppl.]: S340–S345)

Key Words: whole blood; trauma; mortality; hemorrhage; coagulopathy; combat

Background

New evidence in trauma resuscitation - is 1:1:1 the answer?

Timothy E Miller

Perioperative Medicine 2013 **2**:13
https://doi.org/10.1186/2047-0525-2-13 © Miller; licensee BioMed Central Ltd. 2013
Received: 23 October 2012 | **Accepted:** 8 May 2013 | **Published:** 3 July 2013

Conclusions

Reduced crystalloid use upfront, massive transfusion protocols and 1:1:1 in the absence of whole blood have all been shown to improve trauma outcomes. There is growing evidence to suggest that 1:1:1 is the best possible alternative to fresh blood, together with damage control resuscitation. However the principles of damage control resuscitation should only

Background

J Emerg Trauma Shock. 2015 Jan-Mar; 8(1): 21–25.
doi: 10.4103/0974-2700.150392
PMCID: PMC4335151
PMID: 25709248

Warm Fresh Whole Blood and Thoracic Traumain Iraq and Afghanistan

Ryan J. Keneally, Andrew M. Parsons, and Peter B. Willett

Results:

Patients transfused with warm fresh whole blood in addition to component therapy had a higher mortality rate than patients transfused only separated blood components (21.3% vs. 12.8%, $P < 0.001$). When controlling for covariates, transfusion of warm fresh whole blood in addition to component therapy was not associated with increased mortality risk compared with the transfusion of component therapy only (OR 1.247 [95% CI 0.760-2.048], $P = 0.382$).

Conclusion:

Patients with combat related thoracic trauma transfused with warm fresh whole blood were not at increased risk for mortality compared to those who received component therapy alone when controlling for covariates.

Objective

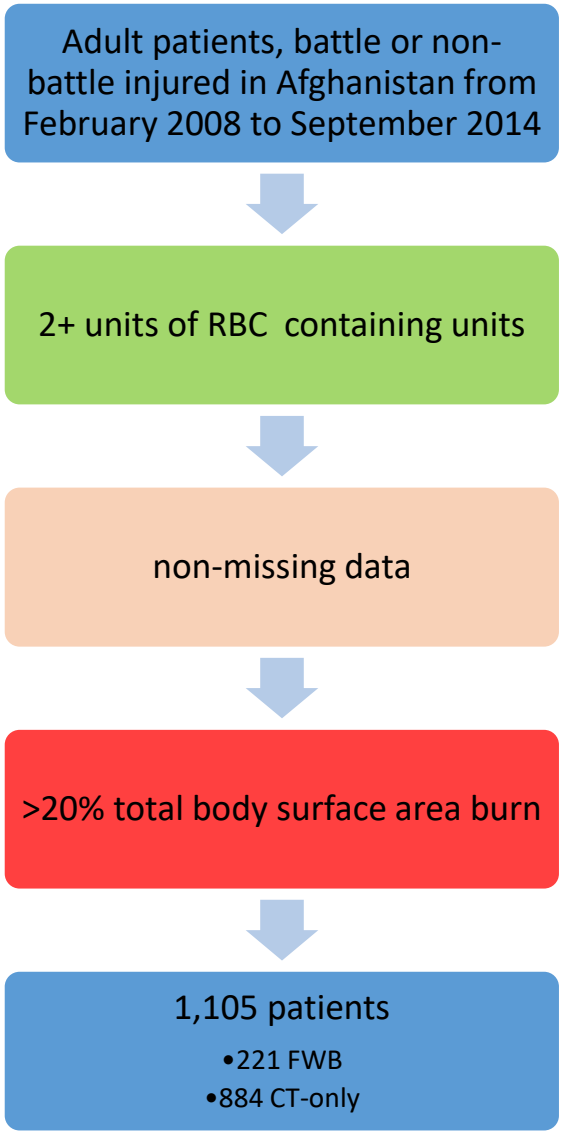
To compare early survival after injury in combat casualties resuscitated with FWB vs. CT-only after appropriate adjustment for both immortal time bias and the severity of injury and bleeding

Outcome

- Primary Outcome: mortality within 6 hours of Role 2 facility admission
- Secondary outcomes:
  - the total sum of RBC-containing transfusions
  - total sum of unit blood product transfusions among patients who survived at least 6 hours in the Role 2 facility

Methods- Study Population

- Retrospective study
- Role 2 Database
- Exposure: FWB vs CT



Methods

- Matching factors and categorization of FWB patients into 29 unique strata
- Selection of CT patients by identical matching to the profiles specified by the 29 strata
- Analysis strategies
  - For mortality outcome: multi-level mixed model logistic regression with stratum as the random intercept to appropriately adjust for both matching and other covariates
  - For sum totals of blood products: Survival average causal effect modeling with adjustment for matching factors and the severe head injury covariate using multiple logistic regression

Characteristics of FWB patients

	n	%
Age, median (IQR)	26	(22, 30)
Gender		
No. of patients without missing data	220	99.5
Male	217	98.2
Injury Type[a]		
Penetrating	205	92.8
Other	16	7.2
Head injury[a]		
Severe	13	5.9
Moderate	6	2.7
None	202	91.4
Patient affiliation[a]		
US military	84	38.0
Other	137	62.0
Tourniquet use[a]	103	46.6
Prehospital blood[a]	7	3.2

[a]Multilevel mixed-effects logistic regression adjusted simultaneously for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and for the covariate head injury assessed by maximum head abbreviated injury scale score or Glasgow coma scale when MAIS missing

Characteristics of FWB patients

	n	%
Hourly rate of unit RBC/FWB transfusion[a, b]		
Low	59	26.7
Medium-Low	62	28.1
Medium-High	55	24.9
High	45	20.4
Shock[c]		
Yes	143	64.7
No	78	35.3
Dose of FWB[d]		
Low	66	29.9
High	155	70.1
Admission base deficit, median (IQR)	-7	(-13, -4)
Median (IQR) MAIS score, median (IQR), n=132	3	(2, 3)
Median (IQR) Injury severity score[f], median (IQR), n=132	9	(5, 14)
Time from point of injury to Role 2 facility, median (IQR), n=113	60	(35, 117)

[a]Multilevel mixed-effects logistic regression adjusted simultaneously for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and for the covariate head injury assessed by maximum head abbreviated injury scale score or Glasgow coma scale when MAIS missing

[b]Hourly rate of unit RBC/FWB transfusion was calculated as units of FWB or RBCs divided by patient Role 2 length of stay with a maximum length of stay of 6 hours. Hourly rate of unit RBC/FWB transfusion were examined in quartiles (Low, 0.33333 to <1.71429; Low-Medium, 1.71429 to <2.88462; High-Medium, 2.88462 to 4.90909; High, ≥4.90909)

[c]Shock was defined as admission systolic blood pressure ≤90, admission pulse ≥120 or shock index ≥0.9

[d]Dose was calculated as units of FWB divided by the total units of FWB and RBCs. Patients categorized as low dose received a dose <0.33, while high dose patients received a dose ≥0.33

Unadjusted[a] pre-specified outcomes

	FWB		CT-only	
	n	**%**	**n**	**%**
Mortality within 6 hours of Role 2 facility admission	15	6.8	56	6.3
≥1 unit of blood product				
Plasma	187	84.6	709	80.2
Platelets	20	9.0	119	13.5
Blood products, units, median (IQR)				
RBC containing units[b]	12	8.0-19.0	4	2.0-7.0
Plasma	5	2.0-8.0	3	2.0-6.0
Platelets	0	0.0-0.0	0	0.0-0.0
Total	17	11.0-27.0	8	4.0-12.0

Abbreviations: FWB, fresh whole blood; IQR, interquartile range; RBCs, red blood cells

[a]Unadjusted for matching with variable ratios of CT-only:FWB patients in each stratum. See Results Section for findings from the appropriately adjusted analyses.

[b]RBC containing units means FWB or RBCs

Primary results

Adjusted odds of mortality in FWB patients (n=221) versus matched[a] CT-only patients (n=884)

	n	Deaths	Odds Ratio	95% Confidence Interval		p value
FWB	221	15	0.27	0.13	0.58	0.001

Abbreviations: FWB, fresh whole blood

[a]Multilevel mixed-effects logistic regression adjusted for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and the covariates head injury and interaction between head injury and FWB use

Results- secondary analysis

Adjusted odds of mortality by dose of FWB received versus matched[a] patients who received CT-only (n=884)

	n	Deaths	Odds Ratio	95% Confidence Interval		p value
Low Dose[b]	66	10	0.12	0.04	0.38	<0.001
High Dose[b]	155	5	0.54	0.22	1.34	0.184

Abbreviations: FWB, fresh whole blood; RBC, red blood cell

[a]Multilevel mixed-effects logistic regression adjusted for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and the covariates head injury and interaction between head injury and FWB use

[b]Dose was calculated as units of FWB divided by the total units of FWB and RBCs. Patients categorized as low dose received a dose <0.33, while high dose patients received a dose ≥0.33. Referent equals no dose.

Results- sensitivity analysis

Adjusted odds of mortality in FWB patients (n=68) versus matched[a] CT-only patients (n=354)

	n	Deaths	Odds Ratio	95% Confidence Interval		p value
FWB	68	3	0.15	0.03	0.78	0.024

Abbreviations: FWB, fresh whole blood

[a]Multilevel mixed-effects logistic regression adjusted for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and the covariates head injury, interaction between head injury and FWB use, injury severity score, maximum abbreviated injury scale, admission base deficit, age, gender, shock, and time from injury to Role 2 facility

Results- 2nd sensitivity analysis

Adjusted odds of mortality in FWB patients (n=217) versus matched[a] CT-only patients (n=864), excluding decedents who did not respond to CPR

	n	Deaths	Odds Ratio	95% Confidence Interval		p value
FWB	217	11	0.35	0.15	0.84	0.019

Abbreviations: FWB, fresh whole blood

[a]Multilevel mixed-effects logistic regression adjusted for the matching factors of injury type, patient affiliation, tourniquet use, prehospital blood, and hourly rate of unit RBC/FWB transfusion and the covariates head injury and interaction between head injury and FWB use

Results- between group difference

- Sum total of unit RBC-containing transfusions among study patients predicted to have survived at least 6 hours
  - No difference
  - $p = 0.426$
- Sum total of all blood product transfusions
  - No difference
  - $p = 0.685$

Conclusions

- FWB improves early survival in combat casualties
- Sorry, I don’t understand the stats well enough to make much interpretation beyond this. Need to address:

Secondary outcomes:

- the total sum of RBC-containing transfusions
- total sum of unit blood product transfusions among patients who survived at least 6 hours in the Role 2 facility

Limitations

Recommendations for future research

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We hope this work honors the sacrifice and service of the U.S. military members whose records were reviewed for this study.

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Questions?

Development of a Standardized Competency Program for Combat Medical Readiness

MAJ Allison Ferro[1], Krystal Valdez-Delgado[1], Patricia Colston[1]
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The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense

Introduction/Background

- **There is currently no standard program for clinical pre-deployment readiness, nor documentation tool of individual competency and training.**
- The 2017 National Defense Authorization Act included a requirement to establish a standardized training curriculum for pre-deployment training and to formally partner with civilian trauma centers to ensure military clinicians are exposed the volume and acuity of trauma and burn patients.
- USAISR/BAMC has been established as a premier military readiness platform at DoD's only Level I Trauma and Burn Center. Preliminary results from this pilot have reflected self reported improvements on key skills.
- From Jan. 2015-Sept. 2018 a total of 229 personnel have rotated through the USAISR program.
- Standardized training curriculum in development with the following goals:
  - -Nursing content for Knowledge/Skills/Abilities (KSA) competency development and assessment
  - -Documentation tools for nursing combat readiness
  - -Knowledge assessment test (Nursing, Medic, Tech, Corpsmen) and novel training platforms (gaming)
  - -Simulation scenarios that are easily replicated
  - -Standardized curriculum exportable to a civilian facility

Objectives

- Demonstrate that a comprehensive platform to prepare providers for combat deployment is improved with implementation of a standardized program.
- Aim 1: Create standardized training and sustainment modules for identified combat related skills.
- Aim 2: Demonstrate that a program created for the Burn/Trauma Center is adaptable across the Military Health System (MHS) and Civilian partners.

Methods

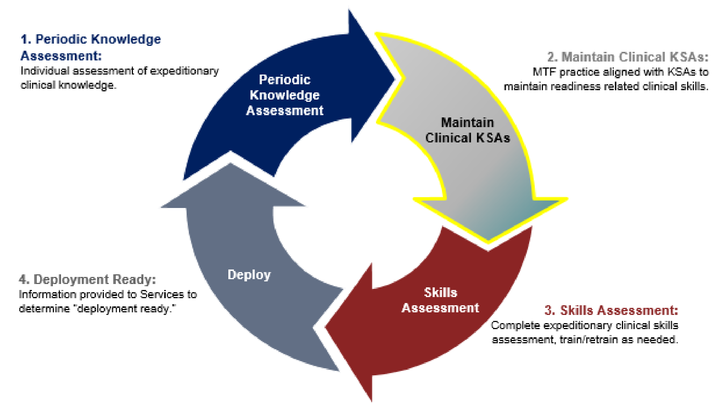
A prospective, cohort project to compare the observed skill and knowledge of combat casualty care (CCC) for nurses/medics/corpsmen/technicians expected to deploy.
Objective metrics:

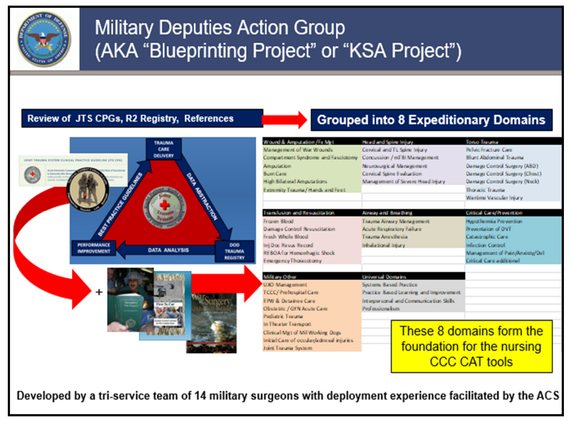
✓ Readiness Estimate and Deployability Index (READI) and Periodic Evaluation Tool (PET) instrument will be used for self assessment

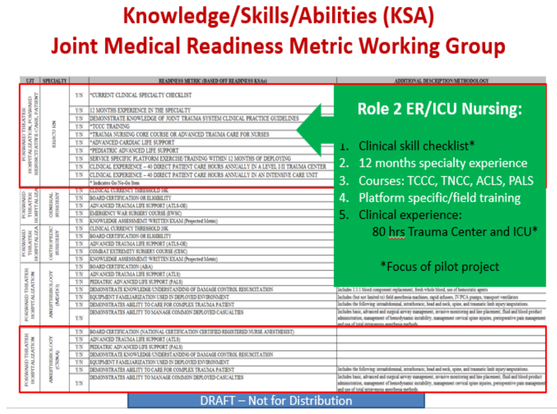
✓ CCC Competency Assessment Tool will be used to evaluate and document clinical skills and patient care hours

Each group was assessed using the aforementioned tools and categorized into two groups: those who received no simulation training and those who did.

Methods







USAISR/BAMC Pre-deployment Program

Pre-deployers
- -Forward Resuscitative Surgical Teams
- -Hospital Centers
- -Individuals

Duration
- 1-4 week rotation

Location
- Burn Center and Emergency Department

Goals
- Clinical experience, burn knowledge
- Documentation of competency in CCC

USAISR Burn Center Clinical Pre-Deployment Training Program Components

Didactic Content*

Advanced Burn Life Support Course
Thermal Injuries I & II
Fluid Resuscitation
Inhalation Injury
Prolonged Care & Burn CPG
Burn Sepsis
Infection Control
Don't get burned by drugs
Wound Care Foundation
Patient Packaging/Transport
JTS Teleconference
*CEUs available

Simulation Scenarios

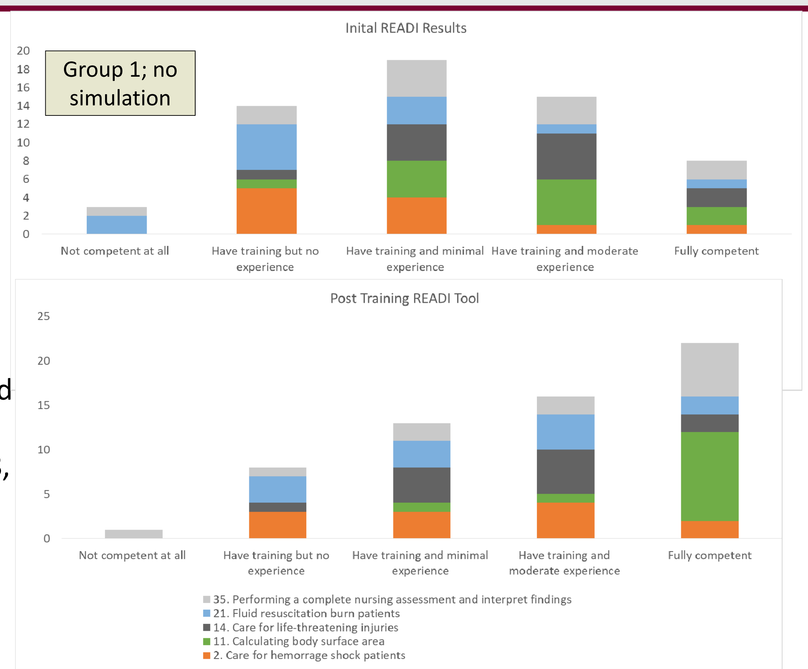
Initial burn management
Pediatric trauma care
Management of poly-trauma patient
- Non-compressible torso hemorrhage
- Fresh whole blood collection & administration
- Management of traumatic brain injury

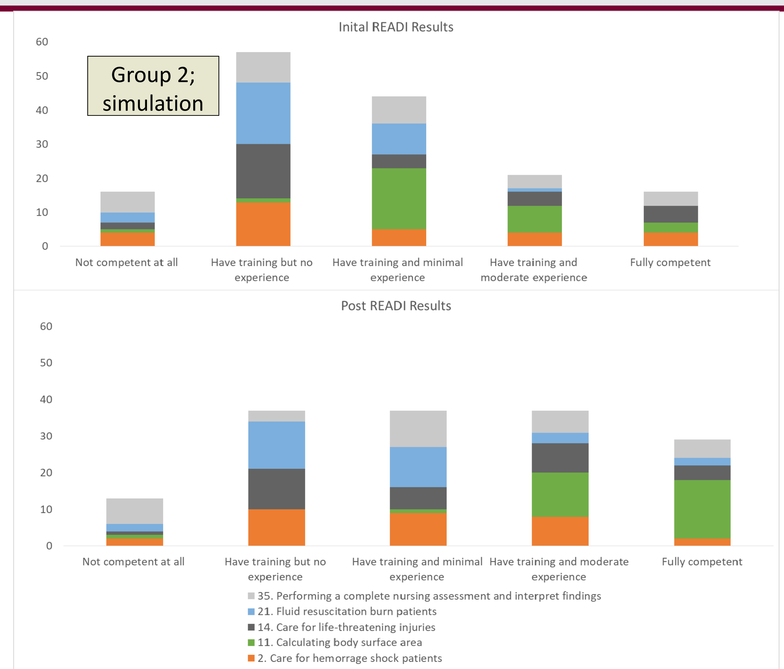
Preparation of patient for transport
- Burn Flight Team scenarios
- Equipment:
  Field ventilator, infusion pump, lab

Preliminary Results

Demographics

- 42 total: 18 Female, 28 Male
- Average age 26-30
- All assigned to field units with 28/42 having deployed previously in current role
- 40/42 have conducted field training in the last year
- Specialties: CRNA=1, RN=8, LPN= 17, medic=10, surgical tech=3, other=3





Summary/Future Implications

- Upon completion of training, both groups reported improved competence on critical elements.
- USAISR/BAMC collaboration will optimize assets of both organizations.
- Project is directly aligned with Defense Health Agency aims through the KSA Project and 8 domains of Combat Casualty Care.
- Pilot project will result in a program that is standardized, exportable, and offers clear documentation of required readiness elements.
- Efforts underway to maximize efficiency of documentation using available electronic resources (e.g., Elsevier Clinical Skills Learning Management System) and add Knowledge assessment test to assess understanding of Clinical Practice Guidelines and CCC concepts.
- Civilian centers could replicate this training platform for community partners to facilitate hands-on experience in preparation for real world civilian mass casualty.

Acknowledgements

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Photo Credit: Dr Steven Galvan, USAISR PAO

An Assessment of Pre-deployment Training of Army Nurses and Medics

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The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

Background

- Clinicians face several challenges when caring for trauma patients on the battlefield. Combat casualty care may include:
  - Treating patients while under attack
  - Resource constraints
  - Periods of limited visibility/darkness
  - Rugged terrain
  - Extreme temperatures
- Therefore, optimal preparation for clinicians includes exposure to as many combat trauma situations as possible prior to deployment
- Army nurses and combat medics undergo a wide variety of pre-deployment training events
- The literature contains no evaluation of Army nurse or combat medic pre-deployment training

Objectives

The purpose of this study was to survey trauma care-oriented Army nurses and combat medics to describe the range of pre-deployment trainings they experienced in order to provide guidance on future pre-deployment training requirements

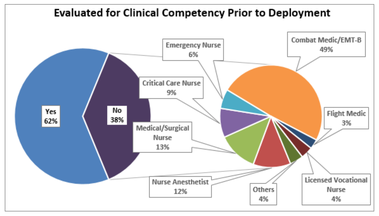
Methods

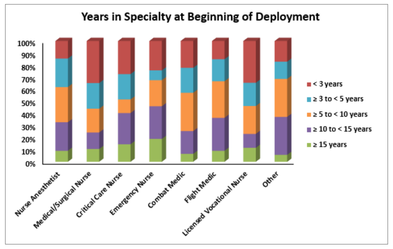
- Survey link sent to military email accounts provided by US Army Human Resource Command
  - Army nurses from active (n=2,344) and reserve (n=2,458) components
  - Active duty combat medics (n=17,535)
- Inclusion criteria:
  - Deployed to a combat theater since 2001
  - Registered nurse (medical-surgical, emergency, critical care), certified registered nurse anesthetist (CRNA), or medic (technician or licensed vocational nurse)
- Intelink.gov survey platform
  - Targeted up to two most recent deployments
  - Captured demographic information, deployment history, and military training received prior to deployment
- Three monthly reminder emails sent to all potential participants
- Survey data analyzed using descriptive statistics

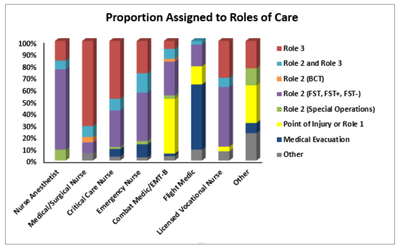
Results

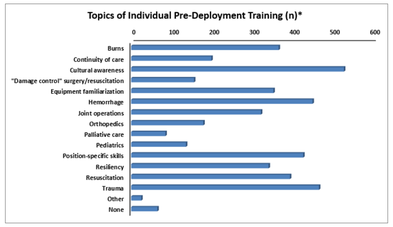
- Of 22,337 emails sent, there were 1,181 respondents (5.3% response rate); 696 (58.9% of respondents) met inclusion criteria

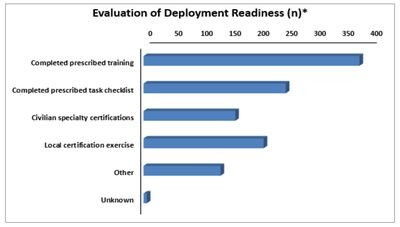
Characteristics of the Participants	n	%
Total Participants	696	100.0
Male	517	74.3
Age		
18 - 24 years	95	13.6
25 - 34 years	329	47.3
35 - 44 years	204	29.3
45 - 54 years	64	9.2
55 - 64 years	4	0.6
Rank		
E-1 to E-4	137	19.7
E-5 to E-6	264	37.9
E-7 to E-9	66	9.5
O-1 to O-3	140	20.1
O-4 to O-6	89	12.8
Active Duty	644	92.5
Area of Concentration or Military Operational Specialty		
Combat Medic	382	54.9
Critical Care Nurse	62	8.9
Emergency Nurse	37	5.3
Flight Medic	33	4.7
License Vocational Nurse	26	3.7
Medical/Surgical Nurse	66	9.5
Nurse Anesthetist	55	7.9
Other	35	5.0
Number of Deployments		
1	269	38.6
2	212	30.5
3	115	16.5
4	58	8.3
5 or more	42	6.0
Location of Most Recent Deployment		
Afghanistan	364	52.3
Africa	13	1.9
Iraq	198	28.4
Kosovo	7	1.0
Kuwait	59	8.5
Syria	17	2.4
Other area (Middle East)	18	2.6
Other area (global)	20	2.9

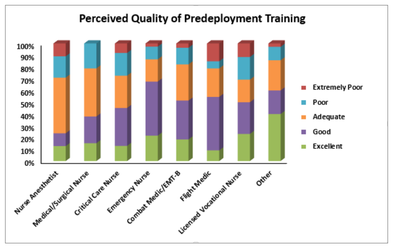


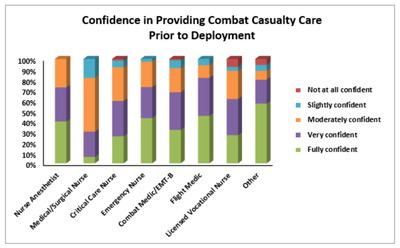


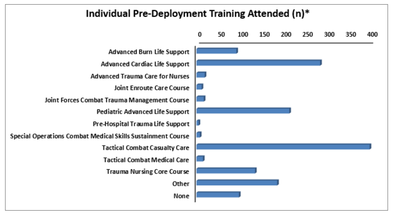


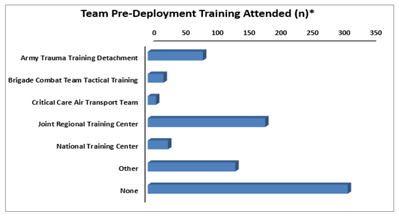


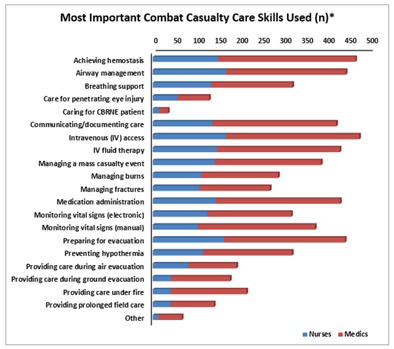


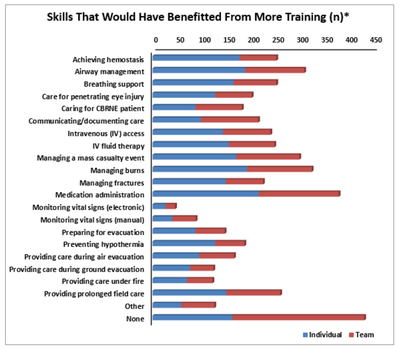












* Totals may be greater than 696 because participants could select more than one option.

Discussion

- Most nurses and medics were satisfied with the quality of their pre-deployment training (when it occurred)
- Nurses and medics believed they were capable of providing effective combat casualty care
- Combat died of wounds rates started to rise recently,1 indicating that the trauma system may have previously unidentified limitations
- Currently unable to link pre-deployment training to patient outcomes; success of training is subjective

Implications for Military Nursing

- Army nurses and medics felt confident and adequately trained to provide trauma care during their deployments. This study is ongoing. Further analysis of the complete data will inform Army Medical Department leaders about pre-deployment training for Army nurses and medics, as well as the respondents' views of the effectiveness of this training.

Limitations

- Survey data only captured pre-deployment training for deployers and not for non-deployers
- Sample not representative of all nurse specialties

Conclusions

- Army nurses and medics felt confident and sufficiently prepared to provide trauma care during their deployments
- Increases in died of wounds rates may indicate that training was not sufficient.
- To better understand the effectiveness of combat casualty care training, the Army must be able to link training events to objective measures, such as patient outcomes.

Acknowledgements

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- This project was conducted under a protocol reviewed and approved by the US Army Institute of Surgical Research Regulatory Office
- Conduct of the survey was approved by the Army Research Institute, Control Number DAPE-ARI-AO-18-01

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Using the Delphi Technique to Determine Core Components of a Nurse Competency Program

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This modified Delphi study determined consensus on core nurse competency program components that apply across the continuum of transition to initial practice, to new specialty practice, to a new role, or within general nursing orientation. The literature review found no published agreement on support and systems for universal transition programs. This broad-based study addressed this gap by identifying core elements within a competency or transition program and then ranking their importance within program structure.

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Competency programs are used to establish evidence of clinical capability of new professional staff members in diverse settings and roles (Blegen et al., 2015; Boyer, Mann-Salinas, & Valdez-Delgado, 2018). These programs may address transitions of student to nurse, from one specialty to another, to a new setting or agency, and nurse to nurse practitioner. The nurse professional development (NPD) practice model identifies *partner for practice transitions* as one of seven key NPD roles and competency management as an essential throughput. This places management of Nurse Competency or Transition Program structure at the core of this specialized practice. Throughout this article, we refer to "competency program" and "transition program." Both of these terms address the structure and systems established to develop and validate care provider competency in the clinical setting.

The need for this project was identified when seeking to update and optimize the on-boarding or orientation system for a tertiary care center within the military health system (Boyer, Valdes-Delgado, Huss, Barker, & Mann-Salinas, 2017; Robbins et al., 2017). Work within the military health system agency introduced multiple concepts that were unfamiliar to the nurse leadership group, thus expert opinion and further evidence was sought. A literature review exposed limited evidence-based data on competency framework recommendations and a lack of consistency in tools used for instruction, competence assessment, and/or evaluation (Edwards, Hawker, Carrier, & Rees, 2015; Kinghorn, Halcomb, Froggatt, & Thomas, 2017; Pasila, Elo, & Kääriäinen, 2017). This study addresses the identified gap in evidence for programs that address foundational competency development and validation, as opposed to annual competency models (Strauss, Ovnat, Gonen, Lev-Ari, & Mizrahi, 2016). Cycles of questions, analysis, feedback, and intervention first outlined contemporary, expert opinion on core program elements and then ranked the components in order of importance. Respondent demographic data allowed analysis of responses as divided by role, experience, education, and military versus civilian medical systems.

PURPOSE

This modified Delphi study identifies and prioritizes contemporary, expert opinion on optimal program components within a nurse competency development and validation model. Expert consensus establishes core elements for programs that facilitate new specialty knowledge and skill development—whether the transition is onboarding new nurses or guiding experienced nurse transition into a new agency, specialty area, or role.

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LITERATURE REVIEW

The literature review presented a broad set of articles targeting new graduate transition to practice or residency programs (Edwards et al., 2015; Goode, Reid Ponte, & Sullivan Havens, 2016; Pasila et al., 2017). The nurse residency programs show great variation in program length and a lack of standardized evidence-based curriculum. Comprehensive reviews completed in 2014 and 2017 show that, "No integrative literature review could be found to summarize available guidelines facilitating transition of final year nursing students to professional nurses" (van Rooyen, Jordan, ten Ham-Baloyi, & Caka, 2018, p. 35). With no comprehensive syntheses to inform program development, there is significant imbalance and variation in the quality of transition programs. The search also exposed a lack of consistency in tools used for instruction, competence assessment, and/or evaluation (Pasila et al., 2017; van Rooyen et al., 2018).

Current publications on competency-based orientation disclose that little is shared regarding specific content recommendations, objectives, or program structure used to support successful transition of nurses into specialty practice (Peltokoski, Vehviläinen-Julkunen, & Miettinen, 2016). Gaps in literature were found related to both identifying program elements and the evaluation of program impact on healthcare outcomes. One integrative review identified the complexity of the orientation or transition phenomena while reporting that current research evidence is not strong. The absence of evidence makes it difficult to establish a comprehensive orientation (Kinghorn et al., 2017; Peltokoski et al., 2016; Strauss et al., 2016).

METHODOLOGY

Delphi methodology is a research approach that is suitable when seeking to solve real-world problems wherein expert opinion is appropriate. Three distinguishing features of the technique include iteration with controlled feedback, anonymity, and statistical representation of participant responses (McPherson, Reese, & Wendler, 2018). The process uses consensus to determine what responses and data are valid and is often used within a mixed methodology model. This makes the model particularly useful for reaching consensus with a diverse, widely spread panel of respondents (Collins, Yen, Phillips, & Kennedy, 2017; Hsu & Sandford, 2007; Naderifar, Goli, & Ghaljaie, 2017).

An independent institutional review board (IntegReview) determined that the study was exempt from human subject research oversight. The study facilitator collected data via a web-based survey system that was not linked with any healthcare agency. The survey tool collected a minimum of publicly available demographic information for the purpose of categorizing responses based on participant experience, education, or background characteristics.

The *credibility* and *dependability* aspects of the study were supported through use of a *study team* for data management and documentation. The decisions, actions, and potential biases of the study facilitator were checked and scrutinized by this team of four reviewers, two of which are nurse scientists with extensive management experience. These experienced researchers hold doctoral (PhD) degrees and ensured fidelity to methodology and an audit trail for study progression. The study team addressed each process step as outlined in Table 1. The component identification phase determined an initial list of program elements based on the literature search, expertise of the study team, and review by nurse leaders in the agency (Collins et al., 2017). Further refinement occurred with evaluation and comparison of current documents and processes.

Within multiple rounds of the Delphi study, participants shared opinions and knowledge based on their experience and expertise in working with transition programs. The facilitator reviewed the material and developed a revised set of summary statements based on each round of feedback. The data analysis and revised elements were reviewed by the full study team prior to the next survey round, and the process continued until participants reached consensus on core program elements. The technique was an iterative process that solicited a broad range of opinions from respondents. Both the level of consensus and the occurrence of "no new data elements proposed" (data saturation) determined the final round, wherein the program elements are prioritized (Hsu & Sandford, 2007).

SAMPLING METHOD: PANEL SELECTION AND SIZE

The study used a purposeful snowball sample composed of over 120 participants that include both military and civilian healthcare settings (Britten, Traynor, Osmond, & Chenoweth, 2018; Collins et al., 2017). The purposive sampling strategy combined with encouraged sharing (snowballing) of the survey link recruited participants from diverse regions and settings (Naderifar et al., 2017). Recruitment efforts targeted a professional web forum (LinkedIn), regional nurse leadership groups, military health clinical nurse leaders, and affiliate groups of the Association for Nursing Professional Development. Distribution of the first round of the Delphi study occurred via e-mail communications, and survey participants were invited to forward the survey link within their network of nurse leaders and clinical educators (Collins et al., 2017). The study protocol did not limit the number of participants, and "snowballing" of respondents expanded the sample size beyond the initial target groups.

The study team recognized that expertise comes in many guises and may include those who are "experts by experience." Thus, the study sought to include respondents from groups representing both decision makers who will use the outcomes and professional staff members

TABLE 1 Process for Identifying Core Program Components		
Development Phase	**Process Steps Engaged**	**Methods Utilized**
Component identification	1. Clarify expected concepts and current practice	√ Environmental scan using key terms to identify initial list of components
	2. Generate a component list	√ Complete line-by-line document analysis of forms and process in current use
	3. Review of list by study team and clinical nurse leaders/educators	
E-Delphi survey process and analysis to expand, condense, and clarify listing of components	4. Consider inclusion, merging, modification, or removal of items based on Delphi responses—Rounds 1 and 2	√ E-Delphi via survey in three rounds with assessment for clarity, content, and face validity
	5. Evaluate survey comments for elimination or clarification of listed elements	√ Multivoting, survey, comments collected and analyzed for adapting list of identified components
Ranking of identified program components	6. Third Delphi round to finalize program components	√ Final Delphi round to include ranking of items on a Likert scale of 1–5 along with further comments
	7. Likert ranking scale engaged for prioritizing list of components	√ Content validity ratio ranking

from transition to practice support teams (Hsu & Sandford, 2007). The expertise of the respondents provides one measure of validity as respondents apply their leadership background, graduate education, and experience to identify specific elements for competency or transition program delivery. Basic demographic information submitted with each survey allowed grouping of data based on participant settings, role, education, and practice experience to determine if those variations generated any trends within responses.

Ayre and Scally (2014, p. 85) produced a table of exact values for content validity ratio (CVR) that detailed the number of experts agreeing that an element is essential. Based on their work, the minimum sample size was set at 40 respondents. With this sample, the CVR table required agreement of greater than 65% for statistical validity.

DEVELOPMENT OF THE FIRST QUESTIONNAIRE

An environmental scan and a document review were completed as part of gap analysis and study plan development. The search terms of "competency," "orientation," "transition program," and "new specialty" were used in CINAHL, PubMed, and Google Scholar. The component identification phase included this literature review plus line-by-line analysis of the agency's competency program documents by an NPD specialist (Collins et al., 2017). Based on current practice and the literature review, an initial list of 39 survey items was detailed and categorized under section headings of Demographics, Transition Program Structure, and Program Documentation. Nurse managers and clinical specialists from the involved tertiary care center reviewed the proposed list of elements to identify possible gaps or concerns. The resultant list provided a starting point for the Delphi Study data collection. Six of the 39 items solicited demographic data in the initial survey, leaving 33 items specific to program components, documents, and delivery.

CONDUCTING THE STUDY

The study team engaged the Delphi technique to distribute a list of program elements that could be refined based on respondent feedback. Rounds 1 and 2 were conducted with program elements presented within a survey form, along with specific directions. Respondents were asked to identify whether they believed that each element should be (a) included in the competency program framework, (b) included with modifications, or (c) excluded from the program (Britten et al., 2018). The instructions requested specific recommendations for modification of the statement or an explanation of "why exclude?" if that option was selected. Respondent comments were used to modify statements, expand upon stated rationale or examples, combine related items, and/or "add to" the elements where indicated. With a high level of consensus achieved after Round 2, the third study round asked respondents to also rank the level of importance of each element.

DATA AND ANALYSIS

Within data analysis, recommendations for revisions, additions, merging, and deletions held equal importance to

accepting the element as stated. Data were reviewed using an iterative process to identify salient themes and concerns related to transition program delivery (Hsu & Sandford, 2007). In each round, the respondent's comments, recommendations, and wording were used to revise the stated program elements or add to the rationale, and then the study team moved to the next process step. Participant demographic data did not track which respondents participated in prior rounds, but the final sample size was larger than the previous samples, indicating either more extensive sharing of the survey link or increased response rate from those receiving study communications.

The total number of respondents for Round 1 was 97 with 73 usable responses. Of the thirty-nine items in the survey, the first six were directed at demographic data, leaving 33 items that offered potential program components. There were occasional votes that requested elimination of an item, although often the "reason for deletion" was absent, revealed misunderstanding of the item, or referred to unrelated issues. From a total of 296 comments submitted by respondents, 33 were linked with a vote for elimination. Frequently, the rationale for exclusion recommended merging the content with another item. Compiled data for each program element showed support for inclusion at 94% or greater; thus, none were deleted. Integration of participant feedback resulted in adding detail to rationale and/or examples for each program element from this round, and the format of demographic information was changed to address all characteristics within a single-survey item where participants selected "all that apply."

The second round of the Delphi study engaged 81 respondents with 55 usable surveys. Of the 33 potential program elements, 23 received 100% respondent support or a recommendation for merging with another survey item. There were a total of 247 respondent comments from this round, with 50 of those linked to a vote for merging or elimination. With related items merged as directed by respondents, the list of remaining core components contained 20 elements. Data analysis supported retaining the full set of 20 modified statements.

The third and final survey round solicited responses from a total of 118 participants, with an 84% (n = 99) completion rate. Demographic data from the final round reveals that 95% of the respondents had 6 years or more of experience, with 68% reporting more than 16 years. In this round, less than 10% (n = 6) worked in a military medical agency, and 55% identified themselves as clinical educators. Of the 99 respondents, 21% identified as preceptors, 76% reported holding a master's degree, and 29% had completed doctoral studies. Certifications were held by more than 50% of respondents, with many of those focused on NPD. About 10% reported a mixed set of roles that included research, nursing science, or coordinator roles specific to a Magnet program, clinical support, or training specialist (with the third round offering 99 responses, the percentage and count numbers match when numbers are rounded down).

In this final round, participants ranked the importance level of the 20 program items, as well as offering a final set of comments. The survey tool directed a ranking for each element on a 5-point Likert scale of 5 = *very important* to 1 = *not important*. Participants were allowed to skip elements upon which they held no opinion; thus, the total responses for each item in the final round were either 98 or 99, with the blanks scattered across various elements. Initial data analysis included descriptive statistics to determine the mean, mode, range, and standard deviation for each program element as charted in Table 2. Although a small majority of items ranked within a range of 3 points, Table 2 shows Item 6 as being the only element that was ranked within a range of 4 points. That element is stated as, "Apply concepts of sampling to the selection of competency validation criteria that require confirmation within an agency and unit orientation." This proposed program element raised the most questions and concerns from respondents. Comments included the statements, "Not sure about this one. I worry about the verbiage"; "This statement cannot stand alone. I don't think the average NPD specialist is going to know what 'the concept of sampling' means"; and "teach preceptors and educators about sampling concepts and application."

The next step of analysis determined the percentage of agreement on importance for each element, which is core to calculating the level of CVR validity. The study outcomes detailed in Table 3 significantly exceeded the critical value of 65% agreement for a panel size of 40. With a panel size of 99 respondents, the lowest ranked item gained 80% level of agreement, and more than half the items ranked above 90%. When the chart of program elements was sorted based on their percentage ranking, the statements are set in a measured order of high to low agreement on importance. Along with prioritizing program elements, participants submitted an additional 112 comments related to competency program structure, documentation, and delivery issues. None of the 20 program components was recommended for elimination in the final round.

DISCUSSION

The modified Delphi process was used to determine and shape statements and examples to communicate specific elements that comprise a nurse competency program. Response rates varied for each study round. Changes in number of respondents may have been predictable as the study did not limit subsequent rounds to prior participants and sharing of the survey link was encouraged. Round 1 produced 73 usable survey responses, whereas the final round gained 99 responses. The expanded participant sample served to affirm *transformability* and

TABLE 2 Descriptive Statistics for Competency or Transition Program Elements					
Program Item	Mean	Median	Mode	*SD*	Range
Item 1	4.78	5	5	0.42	1
Item 2	4.56	5	5	0.58	2
Item 3	4.71	5	5	0.56	3
Item 4	4.54	5	5	0.64	2
Item 5	4.35	4	5	0.73	3
Item 6	4.23	4	4	0.79	4
Item 7	4.35	5	5	0.77	3
Item 8	4.60	5	5	0.65	3
Item 9	4.57	5	5	0.61	2
Item 10	4.28	4	4	0.74	3
Item 11	4.66	5	5	0.48	1
Item 12	4.35	4	5	0.72	3
Item 13	4.31	4	5	0.79	3
Item 14	4.38	4	5	0.68	2
Item 15	4.63	5	5	0.58	2
Item 16	4.43	5	5	0.72	3
Item 17	4.17	4	5	0.82	3
Item 18	4.50	5	5	0.65	3
Item 19	4.33	4	4	0.64	2
Item 20	4.58	5	5	0.64	3

some aspects of *confirmability* for program elements as stated within the surveys. As new participants were enrolled for subsequent study rounds, they submitted feedback that supported previously contributed data and reflected the fit of results to their own experiences.

With extensive demographic questions posed at the beginning of the survey, many respondents completed that section without entering any responses specific to core program elements. To address this issue of incomplete surveys, subsequent tools were revised to request all applicable demographics be identified within a single survey item. This format gained sufficient data to sort the submissions by education, experience, credentials, and practice setting once the raw data were formatted in a chart. With the demographics condensed, the percentage of completed surveys rose. Analysis of the various demographic groupings determined that there were no significant differences in responses from respondent subsets.

It is not surprising that all elements ranked at or above a Likert score of four in the final round, as the elements had been reviewed and adapted based on two rounds of feedback. This level of support gave evidence of the efficacy of the prior process steps and the resulting list of core program elements. Ten items had mean scores of 4.5 or higher (see Table 2) when ranked as to level of importance. These point averages may indicate that these elements are especially essential to effective program structure and delivery. Higher rankings may also represent greater familiarity with those program elements as used within current practice, with the remaining elements being less commonly applied in transition programs.

The initial presentation of program elements included examples and/or rationale for only a few selected items. Respondent comments revealed the need to include examples and expand upon rationale to clarify the intent of each and every statement. Panelist responses provided a rich resource of rationale and examples for the statements. Feedback also identified possible gaps in understanding related to certain aspects of program structure. This was especially evident with the two lowest ranking elements of *applying sampling principles within a competency framework* and *concepts of standardized knowledge base*. Feedback for these elements may reveal a need for further inquiry into how the element is used within a competency program.

As the study progressed, the response rate improved, revealing a high level of interest in the project and outcomes. The final list of program elements represents consensus from both civilian and military personnel, inclusive of leadership, clinical preceptors, and nurses from diverse backgrounds and geographic settings. Respondent comments added depth and breadth to the ideas and concepts being analyzed within the study. A total of 645 participant comments were submitted, with many related to program elements, but others addressing core implementation challenges and issues. The comments connected to specific elements often provided strong examples or rationales that were added to the element description. In this manner, the Delphi process created work breakdown structures, identified risks and opportunities, and compiled lessons learned from the experience of multiple NPD and education-focused specialists.

LIMITATIONS AND RECOMMENDATIONS

Although the large sample size and absence of prescriptive participant requirements added diversity, there is no way to quantify that the sample addressed all aspects and populations involved in transition program delivery. This study recruited respondents from nursing education and professional development groups rather than broader healthcare audiences. Further implementation studies are needed to determine whether the program elements are generalizable

TABLE 3 Final List of Program Elements Ranked in Order of Percentage Agreeing on Importance

Core Components of a Nurse Competency or Transition Program		% Agree Important
Item 1	Include systems and planning to ensure safe patient care with effective supervision of learners and transitioning orientees.	100
Item 11	Include an evidence-based delivery system within program structure (such as preceptor program).	100
Item 3	Incorporate strategies for individualized development of critical thinking, competency, and clinical judgment.	97
Item 2	Establish competency development and validation documentation requirements that minimize the administrative work burden for preceptors, educators, and managers.	96
Item 15	Provide clear, concise, concrete, objective and measurable competency criteria within statements of expected performance elements.	95
Item 20	Clarify individual accountability for clinical practice, knowledge base, and ongoing learning as a healthcare professional.	94
Item 18	Ensure "hand-off communications" from one preceptor to the next.	94
Item 8	Establish guidelines for clear communication among transitioning orientees, preceptors, facilitators, and leadership.	93
Item 9	Integrate ongoing formative feedback and evaluation to ensure continuous, prompt development for program, orientee, system, tools, and preceptor.	93
Item 4	Present program criteria that support early identification of those who (a) can complete competency validation quickly, (b) might not be suited to the specialty, or (c) might pose a threat to safe care.	92
Item 19	Include clear directions and scoring key with each set of forms.	91
Item 16	Present clinical performance goals in the manner in which care delivery occurs, where subtasks are inherent to achieving the overall goal.	89
Item 14	Address elements of professional practice at various experiential levels, cultural, and situational awareness—based on role and clinical setting.	89
Item 12	Define and explain appropriate assignment, communication, assertiveness, supervision, roles, and responsibilities.	88
Item 10	Provide time and topics for development and growth, both in and outside clinical time, during and after formal transition program.	88
Item 5	Accommodate varied learning styles and skill development that progresses from simple to complex within an individualized development plan.	87
Item 7	Use a form, format, and process consistent with national standards and facility practices that is adaptable for clinical setting, specialty, or role.	86
Item 13	Present both initial and ongoing performance criteria in the competency validation tool—thus communicating both immediate and ongoing performance expectations.	86
Item 6	Apply concepts of sampling to the selection of competency validation criteria that require confirmation within agency and unit orientation.	85
Item 17	Outline knowledge content related to each performance goal that is standardized within the specialty.	80

to the full continuum of nursing care and for our allied healthcare teammates.

The study identified expert opinion regarding core elements of a competency program. With data submission, study participants also expressed concern that implementation of program elements will face staffing, resource availability, and clinical workload barriers. Additional survey comments revealed gaps in understanding related to specific program elements. Challenging concepts include statements related to accountability, sampling, standardized knowledge, and immediate versus ongoing expectations within professional practice. These elements ranked lower on the scale

of importance and generated multiple comments and questions from survey respondents. Additional focus on challenging concepts deserves consideration for future work, research, and instructional support.

CONCLUSION

This Delphi Study identified and ranked 20 core components of nursing transition or competency programs. As listed in Table 3, the elements may establish guidelines for program structure and documentation. The mean and percentage scores reveal a high level of consensus and support regarding the importance of each element in the final listing.

Study results provide foundational work toward delineating an evidence-based approach for transition or competency program objectives, content, development, and evaluation. Within the survey tools, each program item was further delineated with examples and rationale statements. The additional information will be a necessary component of using these elements to establish an effective transition program. An additional step of transposing the elements into an evaluation tool could further validate specific items and determine efficacy of the concepts in program evaluation.

Considering the significant resources required to support effective transitions within professional practice, refining common program components can ensure that agencies invest scarce resources with the greatest possible efficacy. Program efficacy may impact retention of both new graduate and experienced nurses at the agency, thus improving return on investment in professional development. Further work is warranted to formally communicate what was learned about program elements, related examples/rationale, and implementation issues related to specific program components.

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Transition Into Practice Toward Optimal Performance TIP-TOP

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Contents

- What is TIP-TOP?
  - Evidence-based practice
  - Research
- Points of Contact
  - Who to reach outside Evans Army Community Hospital
- Preceptor Tasks
- New Hire/Transitioning Nurse Tasks
- Benefits for implementing TIP-TOP within your own clinic/unit
- Leadership
  - Data, data, data

What is TIP-TOP?

- Also known as the Vermont Nurses in Partnership ("VNIP") program; also known as Clinical Transition Framework ("CTF").
- A validated, evidence-based practice competency tool to train new and transitioning nurses.
- Comprehensive, customizable validation program that provides for a foundation for safe, effective care in a supportive learning environment.
- Primary function of the preceptor or clinical coach is to collect evidence of clinical competence, foster critical thinking and provide a safe learning environment for both nurse and patient.
- Preceptor should provide evidence-based practice instruction.
- Supported by numerous peer-reviewed publications.

Points of Contact

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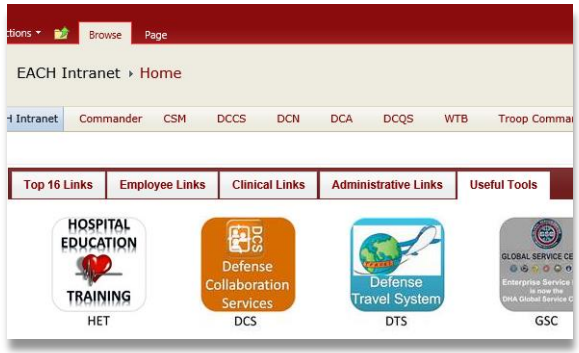
Preceptor: Role & Tasks

- Identify possible and suitable preceptors
  - Must sign and review two documents prior to precepting new hire/transitioning nurse:
    - Preceptor Selection Criteria
    - Preceptor Expertise Criteria – scores do not preclude individual from precepting
  - Attend preceptor workshop (if available and prior to precepting)
  - Pull and put together appropriate documentation for new hire/transitioning nurse
    - Universal Nursing CBO
    - Unit Specific CBO
    - Benner's Novice-to-Expert Scale
    - Periodic Evaluation Tool (PET)
    - Mini Periodic Evaluation Tool (Mini PET)

Where are TIP-TOP Documents Located?



Useful Tools

Click the Hospital Education & Training Icon under the Useful Tools Tab.

TIP-TOP Icon

Locate the Tip-TOP Icon in the list of HET related icons and click it.

TIP-TOP Documents

Everything you need should be found here to include: Universal CBO, Unit/Clinic Specific CBO, Periodic Evaluation Tool (PET) and survey tools.

Before New Hire/Transitioning Nurse's First Assignment…

Certain tools are still needed for both the preceptor and new hire/transitioning nurse to complete!

- Completion of two evaluation tools to be completed at the final PET meeting include:
  - Preceptor Evaluation of the TIP-TOP Program
  - TIP-TOP Evaluation Survey
    - To be completed at the final PET meeting and handed to supervisor/leadership prior to first assignment

Document Storage

Universal and Unit/Clinic Specific

- These documents are to be kept with the new hire/transitioning nurse throughout their orientation.
- Only after all signatures (date and initials & back page) have been completed, all preceptors identified and signed off can the document be stored in the CAF folder.

Periodic Evaluation Tools (PET)

- After review with new hire/transitioning nurse, provide a copy of the original document to the new hire/transitioning nurse.
- Place original copy in unit held personnel folder for safe keeping. Preferable to have lock and key protection as this is a personnel-type document.

Surveys & Preceptor Contracts

- All evaluation survey tools to be held by leadership. These documents are intended to be anonymous.
- Preceptor contracts can be stored in unit held personnel folder. These two documents are not considered to be part of the CAF.

New Hire/Transitioning Nurse Responsibilities

New-to-you staff should be responsible for their own training ensuring they are meeting benchmarks, are following up with preceptors for signatures and/or feedback where appropriate and are receiving EBP training that will ensure success!

Benefits

The "perks" of implementing TIP-TOP within your clinic and/or department

- Designed to provide experience and deliberate practice to facilitate successful transition through learning for those new to a specialty area.
- Provides performance-based documentation with concrete evidence for validating success or termination.
- Clearly defined performance expectations
- Rapid identification when the hire is a 'wrong fit' or threat to safe and effective care
- Quickly identifies when a hire is 'high speed' and can transition to the unit sooner than anticipated
- New hire satisfaction and reduced turn over – feels part of a team or something greater.

Leadership

- Program provides leadership crucial data points and information to include:
  - Whether new hire/transitioning nurse is a good fit for unit/clinic
  - Duration of orientation needed to ensure safe, competent care
  - Ability to make changes to promote evidence-based practice in working documentation
    - Develop clear processes to include: training, tool refinement, policy development and implementation of processes
  - Define what it means to be a competent nurse on the unit or in clinic

Resources

- A number of articles on this program have been published to include:
  - Barba, M., Valdez-Delgado, K., VanFosson, C. A., Caldwell, N. W., Boyer, S., Robbins, J., & Mann-Salinas, E. A. (2019). An Evidence-Based Approach to Precepting New Nurses. *AJN The American Journal of Nursing*, *119*(3), 62-67.
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Characteristics of Iraqi Patients Treated During Operation Inherent Resolve by a Forward Surgical Team

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ABSTRACT Introduction: The combat experience during the re-entry stages of Operation Inherent Resolve was distinct from other recent operations, but there is no published literature regarding these "initial entry operations" experiences among forward surgical teams (FSTs) deployed to Role 2 facilities A descriptive analysis of patients treated by FSTs may provide valuable information for Role 2 surgical teams preparing to deploy in support of initial entry operations. The purpose of this analysis was to describe injury mechanism, wounding patterns and interventions performed by a small FST in the re-entry phase in Iraq. Materials and Methods: From July 17, 2015 to January 31, 2016, a split surgical team with two surgeons and an ER physician documented care for all patients treated by their FST located in Iraq. Given their austere environment, FSTs have limited holding capacity, blood supply, and ability to triage and perform advanced procedures. Patients, who arrived to the Role 2 in asystole, were ineligible for the study. The patient population was Iraqi Security Forces as well as Iraqi civilians. No follow-up data were obtained. Using descriptive statistics, we described the basic demographics, health status, blood utilization, injury severity, and injury pattern of the patient population. Results: The final study population included 300 Iraqi casualties. The majority of patients (96%) were discharged alive. Many patients were 16 years or older (96%), male (96%), Iraqi soldiers (86%), and injured during battle (96%). Over one-third of patients (35%) had a form of metabolic acidosis, 7% were hypothermic, and 18% were in shock at admission. The median amount of blood products used was 6 (interquartile ranges (IQR) = 2–12) units, while the median red blood cells:fresh frozen plasma ratio was 1.2:1. Six or more units of blood were given to 67 (22%) patients. The top three diagnoses were laceration (n = 197, 21%), penetrating injury (n = 185, 19%), and fracture (n = 174, 18%). A high number of injuries occurred in the extremities/pelvis and buttocks (n = 360, 38%) and in the abdomen and pelvic contents (n = 145, 15%). Over a quarter of patients (26%) had critical injuries (i.e., military injury severity score ≥25). Conclusions: Given the Role 2 configuration, these results demonstrate FSTs must be capable of managing critically ill patients with markedly limited resources. This management will include general operations in both adult and pediatric patients, resuscitation with a limited blood supply, and patient assessment with minimal to no diagnostic tools. This analysis can inform resident training, pre-deployment training, as well as sustainment training for surgeons after residency.

INTRODUCTION

The U.S. Army utilizes small mobile surgical teams in far-forward austere environments to perform damage control resuscitation and surgery in order to bridge the time/space gap between wounding and definitive surgical care. These teams are a component of Role 2 care on the battlefield and while there are a few different service-specific configurations of these units, Forward Surgical Teams (FST) have been the most frequently utilized on the battlefield.[1] When deployed in its entirety, the FSTs doctrinally consist of 20 personnel with the ability to perform two simultaneous major surgeries. The FSTs are equipped with red blood cells (RBC), fresh frozen plasma (FFP), and limited quantities of unpooled cryoprecipitate. Often times, these FSTs perform split operations, whereby 10 personnel set up a one-bed operating room at two different geographical sites.[2] With this configuration, both the capacity and capability are diminished: only one surgery can be performed at a time; holding capacity is decreased; and ability to triage and perform advanced trauma life support procedures is reduced. Despite the inherent limitations of a 10 man team, splitting the FST facilitaties surgical coverage for dispersed operations.

There are several publications describing the Role 2 environment and some of the clinical and operational challenges;[3–9] however there is a lack of information in the literature regarding the recent "initial entry operations" from Operation Inherent Resolve experiences at far-forward Role 2 facilities. Initial entry operations in Iraq were unique because logistical support and the patient transport system were unestablished and immature. From July 17, 2015 to January 31, 2016, half of a conventional 20 man FST (10 personnel) were deployed to Iraq. This team was augmented by an additional five personnel (emergency room physician/nurse, operating room technician/nurse, and a certified

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registered nurse anesthetist). To our knowledge, this was the first surgical team to repopulate and work in the austere, immature theater of operations. A descriptive analysis of the workload, injury patterns, and patients treated by this FST may provide valuable information for other Role 2 surgical teams preparing to deploy in support of initial entry operations. The purpose of this analysis was to describe injury mechanism, wounding patterns and interventions performed by a small surgical team in the re-entry phase in Iraq; lessons learned may help inform the manning, training and equipping of Role 2 surgical teams in the future operating environment.

METHODS

This descriptive study was reviewed and approved by the United States Army Institute of Surgical Research regulatory department and was determined to be exempt from review by the Institutional Review Board. Data were recorded by a split surgical team with two surgeons and an emergency room (ER) physician. The data were entered into the Role 2 Database at the United States Army Institute of Surgical Research Joint Trauma System by a single surgeon. The patient population was made up of Iraqi Security Forces to include the Iraqi Army, Federal Police, the Iraqi Counter-Terrorism Service, both Sunni and Shia Militia Groups, as well as Iraqi civilians. All patients arrived to the FST by ground, either by ambulance or personal vehicle. The evacuation times from the point of injury were approximately 90–120 minutes. The FST had minimal holding capability. All patients were evacuated to Iraqi hospitals after stabilization and operative procedures. Most patients were evacuated to Baghdad, usually by Iraqi ground assets. No follow-up data were able to be obtained. No treatment or interventions were given to patients who arrived to the Role 2 in asystole; thus, these patients were ineligible for the study.

The following procedures conducted in the ER were excluded from the analysis: endotracheal Tube (n = 122), central line placement (n = 72), focused abdominal sonography for trauma (n = 279), and abdominal wound exploration (n = 16). Patients were recorded as being in shock if their systolic blood pressure (SBP) was less than 90 mmHg. For one patient, the temperature would not register on a medical grade thermometer, so the temperature was recorded as unreadable.[10] All laboratory values were obtained from either a venous or arterial blood sample. A base deficit >2 was considered metabolic alkalosis, while a base deficit <−2 was considered metabolic acidosis, which was further categorized as: minor <−2 to ≥−10; serious <−10 to ≥−20; and critical <−20.

The military Injury Severity Score (mISS), which was identified by using a form of the abbreviated injury scale, was calculated according to the methods used by Champion et al.[11] Patient injuries were classified according to mISS as follows: mild (1–9), moderate (10–15), severe (16–24), and critical (≥25). In this study, a patient could have more than one classification for mechanism of injury, cause of injury, and injury diagnosis. The causes of injury for patients in this study were categorized as: gunshot, burn, mortar/rocket (i.e., weapon that fires shells at low velocities, short ranges, and high-arching ballistic trajectories), blast (i.e., improvised explosive device or small bomb), and other. Basic demographics, health status, blood utilization, surgical procedures, mISS, and injury pattern of Iraqi patients were described.

All categorical data are presented as count (percent), while continuous data are presented using medians (interquartile ranges [IQR]). Statistical analyses were performed using Stata 14 (College Station, TX, USA).

RESULTS

The final study population included 300 Iraqi casualties. Only 4.0% (n = 12) of the study patients died before Role 2 discharge. The majority of patients were adult, male Iraqi soldiers injured during battle, and transported out of the

TABLE I. Demographics, Characteristics, Vital Signs, and Laboratory Measurements of the Iraqi Patients (n = 300) Treated at a Role 2 in Al Taqqadum, Iraq from July 17, 2015– January 31, 2016

Variable	n(%)
Male	289 (96)
Battle injury	288 (96)
Dead at discharge	12 (4)
RBC:FFP ratio, median (IQR)	1.2:1 (1:1, 1.7:1)
Age at injury	
0–15 years	8 (3)
16+ years	287 (96)
Affiliation	
Iraqi soldier	259 (86)
Civilian	30 (10)
Other	11 (4)
Departure transportation	
Ambulance	239 (80)
Helicopter	36 (12)
Other	5 (2)
Base deficit	
Metabolic alkalosis	15(5)
Normal	102 (34)
Minor metabolic acidosis	85 (28)
Serious metabolic acidosis	13 (4)
Critical metabolic acidosis	6 (2)
Blood transfusion	
0 units	180 (60)
1–5 units	53 (18)
6+ units	67 (22)
Shock	
Yes	54 (18)
No	232 (77)
Temperature	
≤95° F	20 (7)
>95 and ≤97° F	27 (9)
>97° F	218 (73)

RBC, red blood cells; FFP, fresh frozen plasma; IQR, interquartile range.

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Role 2 by an ambulance (Table I). There were 11 patients who arrived with pulseless electrical activity or had cardiopulmonary resuscitation on arrival. Of those 11 patients, three (27%) were resuscitated. Over one-third of patients had a form of metabolic acidosis (n = 104, 35%) with a base deficit as low as −28 recorded. Of the patients with recorded critical base deficits, 4 (67%) died. There were 20 (7%) patients with a temperature less than or equal to 95°F. Almost one-fifth (n = 54, 18%) of patients arrived to the Role 2 in shock, and, of those patients, 23 (43%) had a SBP lower than 70.

Nearly 1,000 units of blood products were transfused (x = 971) (Table II). The median amount of blood products used was 6 (IQR = 2–12) units, while the median RBC:FFP ratio was 1.2:1. Six or more units of blood were given to 67 (22%) patients. RBC's accounted for the majority of the blood product used (x = 553, 57%). The largest amount of blood products were used in August (x = 158, 16%), September (x = 208, 21%), and December (x = 159, 16%), which were also the months with the highest number of surgical procedures (x) and total number of patients (n) (August- x = 193 (19%), n = 65 (22%); September- x = 178 (18%), n = 54 (18%); and December- x = 165 (16%), n = 43 (14%)). Patients treated in the month of August had the highest median mISS (16, IQR = 5–30).

The top three diagnoses were laceration (x = 197, 21%), penetrating injury (x = 185, 19%), and fracture (x = 174, 18%) (Table III). A high number of injuries occurred in the extremities/pelvis and buttocks (x = 360, 38%) and in the abdomen and pelvic contents (x = 145, 15%). Patients injured by a blast (n = 146, 44%) accounted for the highest cause of injury with an average of 2.7 ± 1.7 body regions injured per patient, requiring the highest number of procedures (x = 531, 53%). According to the mISS categorization of this study, 43% (n = 129) of patients had mild injuries, followed by critical injuries (n = 77, 26%). Of the critical patients, 10 (13%) died at the Role 2, and in the severe category, two patients (4%) died. A description of procedures (x = 1,005) is shown in Table IV.

DISCUSSION

In this study, the majority of injuries sustained were penetrating trauma (i.e., blast, mortar or rocket, and/or gunshot wounds), and a disproportionately higher number of procedures occurred in patients injured by blast or mortar/rockets as compared to gunshot wounds. Blast mechanism of injury is common in combat and has been linked to higher injury severity and fatality. In Iraq in 2006, Bird and Fairweather reported a high lethality of improvised explosive devices, linking them to the cause of 62% of hostile deaths.[12] Among Israeli patients with terror-related injuries, a larger proportion of patients sustained explosion injuries as compared to those injured by gunshots had multiple body regions injured (62% versus 47%) and an injury severity score ≥25 (46% versus 34%), respectively.[13] In this study, multiple body areas injured and more than one mechanism of injury for many patients translated into high injury severity scores; complicated wounding patterns required the performance of multiple surgical procedures and transfusion of blood products. Many patients required at least one unit of blood product and over a fifth required more than 6 units of blood. Approximately 1,000 units of blood products were transfused in 7 months with a RBC:FFP ratio nearing the goal 1:1 ratio.[14] Although 40% of the patients were transfused blood product, 34% had metabolic acidosis, and 45% recorded a severe to critical military injury severity score, only 4% of patients died of wounds.

All casualties treated by this FST were Iraqi, either part of the many branches of the Iraqi Security Forces or Iraqi

TABLE II. Blood Utilization, Surgical Procedures, and mISS by Month in Iraqi Patients at a Role 2 in Al Taqqadum, Iraq from July 17, 2015 to January 31, 2016

Month	Blood Product in Units, x(%)				Surgical Procedures, x(%)	Median mISS (IQR)	Total Patients, n(%)
	RBCs	FFP	Cryoprecipitate	Total			
July	49	29	0	78	114	8.5	40
	(9)	(8)	(0)	(8)	(11)	(2–16)	(13)
August	107	51	0	158	193	16	65
	(19)	(14)	(0)	(16)	(19)	(5–30)	(22)
September	123	85	0	208	178	10	54
	(22)	(23)	(0)	(21)	(18)	(4–26)	(18)
October	64	38	4	106	122	10	37
	(12)	(10)	(7)	(11)	(12)	(2–25)	(12)
November	62	47	19	128	132	12	37
	(11)	(13)	(35)	(13)	(13)	(5–17)	(12)
December	80	59	20	159	165	10	43
	(14)	(16)	(36)	(16)	(16)	(5–21)	(14)
January	68	54	12	134	101	15	24
	(12)	(15)	(22)	(14)	(10)	(9.5–20)	(8)
Total	553	363	55	971	1,005	11.5	300
	(57)	(37)	(6)	(100)	(100)	(5–25)	(100)

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TABLE III. Injury Pattern of Iraqi Patients Treated at a Role 2 in Al Taqqadum, Iraq from July 17, 2015–January 31, 2016

Variable	Count (%)
Diagnosis	
Laceration	197 (21)
Penetrating injury	185 (19)
Fracture	174 (18)
Penetrating skin injury	59 (6)
Amputation	43 (5)
Pneumothorax	42 (4)
Burn	38 (4)
Ear injury	37 (4)
Hemopneumothorax	31 (3)
Avulsion	17 (2)
Eye injury	17 (2)
Inhalation injury	16 (2)
Body region	
Lower extremity/pelvis and buttocks	200 (21)
Upper extremity	160 (17)
Abdomen and pelvic contents	145 (15)
Thorax	144 (15)
Face	136 (14)
External	97 (10)
Head, neck and spine	75 (8)
Military Injury Severity Score	
Mild	129 (43)
Moderate	38 (13)
Severe	56 (19)
Critical	77 (26)
Cause of injury	
Gunshot	119 (40)
Burn	27 (9)
Mortar/rocket	19 (6)
Blast	146 (49)
Other	19 (6)
Number of procedures	
Gunshot	368 (37)
Burn	70 (7)
Mortar/rocket	82 (8)
Blast	531 (53)
Other	42 (4)

TABLE IV. Procedures for Iraqi Patients Treated at a Role 2 in Al Taqqadum, Iraq from July 17, 2015–January 31, 2016

Procedure	*x* (%)
Debridement	221 (22)
Other	117 (12)
Suture	115 (11)
Irrigation	108 (11)
Reduction	82 (8)
Insertion	81 (8)
Amputation	41 (4)
Ligation	39 (4)
Exploration	35 (3)
External fixator	33 (3)
Resection	31 (3)
Laparotomy	29 (3)
Splinting	28 (3)
Fasciotomy	23 (2)
Anastomosis	22 (2)

civilians to include women and children. Of the casualties treated, 10% were Iraqi civilians. Similarly, Chambers et al reported 13% of casualties were civilians treated by a US Marine Corps' Surgical Shock Trauma Platoon, comparable to an Army FST in personnel and capability, in Iraq from March 1, 2004 to February 28, 2005.[15] Indigenous forces are often not equipped with the protective gear that has become the standard for USA and Coalition military personnel. While there were a high number of extremity wounds, the lack of sufficient body armor, protective helmets and eye protection by Iraqi Security Forces may have resulted in the high numbers of thoracic, abdominal and ophthalmic injuries.

There are some limitations to consider when interpreting the results of this study. Prehospital transport to the FST was lengthy, unregulated, and point of injury and transport care was non-existent; thus, a survival bias may exist in these results as patients may have died before reaching the FST. In addition, there is no follow-up data available on these patients. All patients were immediately transferred out of the FST after recovery from the postoperative period to host nation hospitals. Despite the clinical outcomes limitations and the survival bias, one of the strengths of this study is that it portrays the realistic scenario of host national care in early entry operations and what care looks like without an established trauma system. Another strength of this analysis is that every patient cared for at this FST was captured in this dataset, therefore providing valuable information regarding workload in this type of environment as well as and accurate representation of injuries seen in initial entry (or in this care re-entry) operations.

The results of this study may be generalizable to Iraqi patients injured in an austere environment with limited resources that included: blood, some diagnostic tools, and communications for quick transfer of patients. Additionally, since the majority of patients were without body armor, the injury patterns were not typical of U.S. military casualties and may represent injury patterns observed in mass shooter and terrorist attacks. This analysis is also relevant to humanitarian missions in areas that do not have a good prehospital system of care given that the patients in this analysis frequently arrived in extremis with complex wounding patterns due to insufficient protective gear, long transit times and no prehospital care.

In conclusion, the combat experience of this single split-operations FST during the re-entry stages of Operation Inherent Resolve was distinct from other recent utilizations of FSTs, Forward Surgical Elements, and Damage Control Resuscitation Teams. Given the unique challenges of early entry operations: lack of established logistical support; immature patient transport system; lack of holding capacity at far-forward sites; and lack of fixed location – this analysis can inform manning and equipping for potential future operating environments. Given the large volume of blood products transfused to this study population, to prepare for future operations, we need to ensure blood is available as far forward as possible. Additionally, this analysis can also help inform

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training in terms of case type and workload. As we look towards the future and as we continue to have a changing operational environment in the U.S. Central Command Theater of Operations – it is paramount that surgical teams are capable of managing severely injured and critically ill patients in an austere far-forward environment with markedly limited resources. Surgeons should have training in patient assessment with little to no diagnostic modality, resuscitating with a limited supply of blood products, and operating independently on all body regions in both adults and children. This analysis will help facilitate overall preparedness for the future operating environment.

PREVIOUS PRESENTATION

Military Health System Research Symposium (MHSRS) held on 27–30 August 2017 at the Gaylord Palms Resort and Convention Center, Kissimmee, FL, USA.

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Combat Casualty Care Readiness Achieved Following Level 1 Trauma/Burn Clinical Exposure Training

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Introduction

- Combat casualty care (CCC) competency is achieved by practicing CCC skills repeatedly in a real-life application.
- There is limited volume and access to critically injured trauma patients within military treatment facilities.
- The U.S. Army Burn Center, co-located with Brooke Army Medical Center (BAMC; a level 1 trauma center), cares for the most critically ill patients in the DoD; the skills required to care for these patients are likely to improve CCC competency.
- Deployable units/individuals, tri-service, attend a 1-3 week clinical rotation through the U.S. Army Burn Center prior to a deployment.
- Clinical rotation allows providers the opportunity to become familiar with the basic elements of trauma care, receive didactic training, and attend Joint Trauma System case study review sessions.
- There is limited data to describe how sending clinicians through these environments for short-term rotations prior to deployment effects CCC competency.

Objectives

The purpose of this study was to determine the CCC knowledge, skills, and perceived readiness achieved during a short term (1-3 week) level-1 trauma/burn clinical exposure at the U.S. Army Burn Center.

Methods

- A universal CCC nursing competency assessment tool (CAT) was developed using evidence-based principles. This tool incorporated the 8 Knowledge, Skills, and Ability expeditionary domains:
  - *wound/amputation/fracture management, head and spine injury, torso trauma, transfusion and resuscitation, airway and breathing, critical care/prevention, other military, universal domains.*
- CCC competencies that could be achieved during a clinical experience were identified by the U.S. Army Burn Center Education Department.
- Self-reported clinical hours were reported daily on a log by each pre-deployer.
- The Readiness Estimate and Deployability Index Survey (READI), a validated tool, was administered before and after each clinical rotation. Questions were on a 5-point scale, 3-point scale, and bi-variable (yes/no).
- A self-evaluation of the ability to independently care for patients within the burn center was administered before and after training. The rating scale included novice (1-3), advanced beginner (4-6), and competent (7 or above); on a 1-10 Benner's scale.
- Skills/knowledge within the defined nursing competency areas were deployed utilizing the Elsevier's Clinical Performance Manager.
- During their clinical exposure, pre-deployers were assigned to preceptors to facilitate clinical experience.

Results

- From April 2016 to June 2019, 92 pre-deployers completed rotations through the U.S. Army Burn Center.
- Of 169 competencies identified in the universal CCC tool, 53 could feasibly be incorporated into the clinical exposure period.
- Average length of rotation was 10 ± 2.5 days and included both didactic training and clinical exposure.
- In 2019, the program was updated to incorporate online skill review and competency tracking. Since the program update, 31 pre-deployers have participated, making a clinical dashboard prototype feasible.
- Average length of clinical exposure was 41± 6 hours (28-56, n=19) of which 17.8 ± 12.2 hours (0-38) were in critical care (burn intensive care or post anesthesia care unit).
- Readiness in clinical nursing increased 4-14% overall, with the greatest self-reported improvements in training and experience in the areas of hemorrhagic shock, ballistic missile injuries, and burn resuscitation (>10% each).
- In the category of operational nursing, blood transfusion and burn injured patient competencies had the greatest increase in self-reported training and experience, improving 13% and 16%, respectively.
- Initial self-perceived competence in the ability to independently care for patients averaged 5 ± 2.4 (advanced beginner). Post-rotation average was 7 ± 2.6 (competent).

Conclusions

- Clinical exposure is beneficial to military medical personnel, however it is infeasible to cover all CCC competencies during a short, 1-3 week rotation.
- Essential competencies, skills, and abilities should be standardized to ensure competence in caring for a combat casualty is achieved over time.
- Currently, no standard competencies exist for tri-service nurses.

A 1-3 week rotation in a level 1 burn and trauma center improves some aspects of clinical and operational readiness, but is insufficient to cover all combat casualty care competencies for pre-deployers.

SCAN ME

Statements

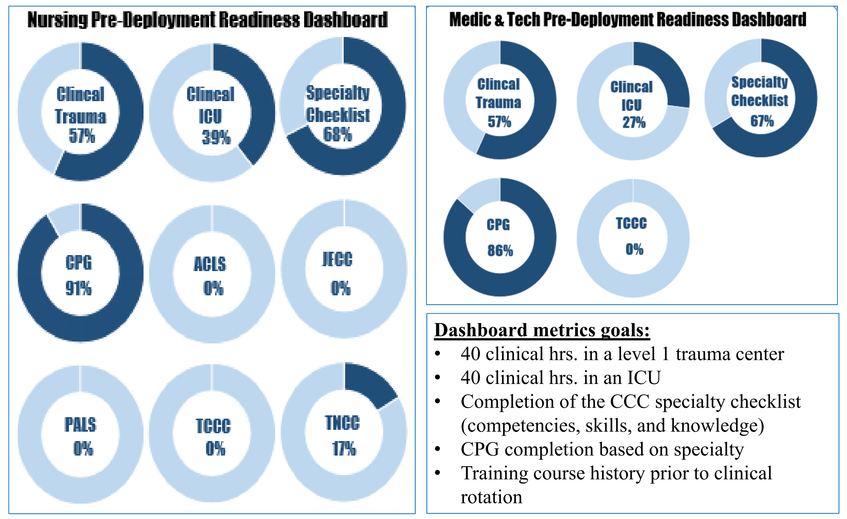
This study was reviewed by the Research Regulatory Compliance Division at the U.S. Army Institute for Surgical Research and was determined to be non-human subject research

Additional Results

- Pre-deployer personnel job code breakdown: Surgeon/Physician/Advanced Care Provider=7; Nurse/LPN=35; Medic=21; Other=29).
- The conversion from paper to electronic documentation resulted in 100% capture of skill and knowledge review (including Joint Trauma System Clinical Practice Guideline content), and provided pre-deployers with 43.5 continuing education hours.

Table 1-Self-reported Competencies on the Readiness Estimate and Deployability Index (READI)	Before n=90	After n=92	% Change
Clinical Nursing (5-point Scale)			
1=No training, no experience; 2=Training, no experience; 3=Training, minimal experience; 4=Training, moderate experience; 5=Training, maximal experience			
Fluid resuscitation of a burn patient (Q21)	2.52 ± 0.87	3.2 ± 1.10	13.6%
Care for hemoragic shock Patients (Q2)	2.94 ± 1.15	3.47 ± 1.14	10.6%
Ballistic missile injuries (Q19)	2.22 ± 1.13	2.74 ± 1.22	10.4%
Care of patients with CRBNE injuries (Q18)	2.16 ± 0.74	2.65 ± 1.00	9.8%
Calculating IV drip without calculator or drug book (Q7)	2.55 ± 1.22	3.02 ± 1.24	9.4%
Field infection control (Q30)	2.64 ± 1.21	3.11 ± 1.15	9.4%
Universal blood donation protocal (Q22)	2.49 ± 1.12	2.96 ± 1.19	9.4%
Implementing triage categories (Q26)	2.93 ± 1.06	3.36 ± 1.15	8.6%
Deciding which patients to see first (Q12)	3.20 ± 1.04	3.60 ± 1.1	8.0%
Use of field ventilator (Q24)	2.52 ± 1.31	2.9 ± 1.42	7.6%
Clinical team leadership (Q27)	2.89 ± 1.29	3.26 ± 1.29	7.4%
Recognition of tension pneumothorax (Q20)	2.91 ± 1.15	3.25 ± 1.23	6.8%
Orthopeduc nursing (Q31)	2.26 ± 1.28	2.58 ± 1.37	6.4%
Instituting standing orders (IV, X-rays, fluids, meds) (Q9)	3.12 ± 1.30	3.44 ± 1.25	6.4%
Antepartum/Postpartum care (Q29)	2.45 ± 1.25	2.76 ± 1.29	6.2%
Care for refugee or enemy prisoners of war (Q28)	2.42 ± 1.18	2.66 ± 1.25	4.8%
Care for life threatening injuries (Q14)	3.22 ± 1.19	3.46 ± 1.12	4.8%
Advance Cardiac Life Support without a physican (Q13)	2.70 ± 1.33	2.93 ± 1.44	4.6%
Airway management (Q25)	3.38 ± 1.04	3.59 ± 1.14	4.2%
Neurosurgical nursing (Q32)	2.07 ± 1.24	2.27 ± 1.41	4.0%
Disease, non-batttle injuries (Q23)	3.26 ± 1.28	3.44 ± 1.24	3.6%
Operational Nursing (5-point Scale)	**Before**	**After**	**% Change**
1=No training, no experience; 2=Training, no experience; 3=Training, minimal experience; 4=Training, moderate experience; 5=Training, maximal experience			
Burn Injured Patient (Q44)	2.03 ± 0.97	2.82 ± 1.21	15.8%
Blood transfusions (Q39)	2.71 ± 1.47	3.34 ± 1.38	12.6%
Field hosptal set up (Q49)	2.94 ± 1.40	3.41 ± 1.35	9.4%
Reporting an unlawful act or conduct (Q47)	2.86 ± 1.25	3.29 ± 1.26	8.6%
Roles of care (Q46)	3.01 ± 1.22	3.41 ± 1.19	8.0%
Field sanitation and hygine (Q48)	3.15 ± 1.04	3.52 ± 1.18	7.4%
Evacuation/Transport (Q45)	2.93 ± 1.17	3.25 ± 1.20	6.4%
Physical Assessment Component (5-Point Scale)	**Before**	**After**	**% Change**
1=Low; 2=Somewhat low; 3=Moderate; 4=Nearly high; 5=High			
List five examination techniques to perform physical examination (Q34)	2.82 ± 1.31	3.42 ± 1.26	12.0%
Identify components of physical examination (Q33)	3.39 ± 1.06	3.75 ± 1.14	7.2%
Perform complete nursing assessment and interpret abnormal findings (Q35)	3.1 ± 1.31	3.36 ± 1.39	5.2%

Figure 1- Pre-deployment Nursing and Medic Dashboard



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Analysis of Far Forward Ocular Trauma among Combat Casualties in Afghanistan

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Introduction

- Far forward surgical units in Afghanistan are responsible for performing damage control surgery and resuscitation. Although equipped and prepared to handle the most severely injured casualties, these teams do not specialize in ocular trauma.
- Ocular injuries are often difficult to detect and triage, and if they are missed or mistreated, they may lead to vision loss. Ideally, only an ophthalmologist should treat patients for ocular trauma, but this specialty is rarely available on the battlefield.
- Additionally, eyesight is often overlooked among the triad of life, limb, and eyesight.
- Currently, far forward surgical units are instructed to use fox shields as a temporary intervention for ocular trauma before transporting patients to the next level of care.
- In a prolonged field care situation, expeditious transport may not be possible. Thus, it would be beneficial for medical planners to understand the types of ocular injuries that occur at far forward locations in order to ensure that providers are prepared to diagnose and manage these injuries prior to further damage or vision loss.

Objective

The purpose of this study was to analyze ocular traumas identified by far forward surgical teams in Afghanistan in terms of likeliness to result in permanent vision loss.

Methods

- Data from the Joint Trauma System Role 2 database were used to identify patients with ocular injuries.
- Adult patients who were injured in Afghanistan from February 2008 to September 2014 were included in this analysis.
- An ophthalmologist reviewed all eye injuries and determined those that were 1) likely, 2) possibly, and 3) less likely to result in loss of vision. Loss of vision was defined as permanent or significant loss of vision.
- Only initial ocular injuries were considered for potential causes of vision loss.
- Indirect injuries such as severe traumatic brain injury, arterial gas embolism, and post-hypotensive ischemic optic neuropathy were not considered potential causes of loss of vision due to dataset limitations.
- Descriptive statistics were used to evaluate patient characteristics by demographics, mechanism of injury, and interventions.
- Functional capacity index (FCI) was used as an approximate measure of outcomes 12-months following the injury. Possible scores range from 1 (worst) to 5 (best).

Results

- In our dataset, 320 patients with ocular injuries were identified with 375 injuries. Blast injuries accounted for approximately 252 (79%) patients with ocular injuries.
- Of the 24 injury diagnosis, 9 were likely to result in vision loss, 2 possibly resulted in vision loss, and 13 were less likely to result in vision loss.
- The frequency of these injuries included 102 (27%) likely, five (1%) possibly, and 268 (71%) least likely to result in vision loss.
- Injuries likely to result in vision loss included:
  - eye avulsion/enucleation (n=20)
  - retinal detachments (n=2)
  - cornea lacerations (n=3)
  - sclera laceration/rupture or injury (n=74)
  - choroid rupture (n=1)
  - eye injuries with retained intraocular foreign body (n=1)
  - Face penetrating injury, massive destruction of whole face with eyes (n=1)
- Injuries that possibly resulted in vision loss included:
  - cornea burn (n=4)
  - vitreous hemorrhage (n=1)
- Of the 102 patients with injuries likely to result in vision loss, 1 had a FCI=1, 20 had a FCI=2, 4 had FCI=3,, and 77 had a FCI=5.
- Primary procedures at the Role 2 included fox shields (n=77, 44%), eye irrigations (n=48, 27%), facial fractures (x-rays and reduction; n=28, 16 %), eye exams (n=12, 7%), and other procedures (n=11, 6%).

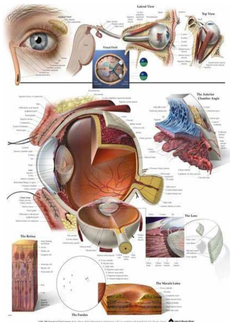
Exposure to blasts accounted for 79% of patients with ocular injuries.

Almost 1/3 of ocular injuries in combat likely or possibly resulted in vision loss.

Table 1. Ocular Injuries

Injuries Resulting in Vision Loss	Bilateral	Single	Unknown	Total Injuries
General Eye Injury	**22**	**75**	**13**	**110**
Foreign body, eye	17	49	13	79
Eye avulsion; enucleation	3	17	0	20
Eye injury, not further specified	2	7	0	9
Eye injury, retained intraocular foreign body, anterior chamber	0	1	0	1
Face penetrating injury, massive destruction of whole face with eyes	0	1	0	1
Corneal Injuries	**42**	**38**	**14**	**94**
Corneal abrasion	37	35	14	86
Cornea burn	3	1	0	4
Cornea laceration	1	2	0	3
Cornea injury, not further specified	1	0	0	1
Scleral Injuries	**13**	**51**	**10**	**74**
Sclera, includes globe	11	50	10	71
Sclera laceration; rupture	1	1	0	2
Sclera injury, not further specified	1	0	0	1
Face and Eye Area Fractures	**12**	**38**	**15**	**65**
Maxilla fracture, including maxillary sinus	8	18	8	34
Orbit fracture	3	16	7	26
Maxilla fracture	0	2	0	2
Orbit fracture, closed or not further specified	0	1	0	1
Orbit fracture, inferior orbital rim, closed or not further specified	1	0	0	1
Zygoma fracture	0	1	0	1
Conjunctival Injuries	**4**	**17**	**5**	**26**
Conjunctiva injury	4	17	5	26
Eye Vessel and Nerve Injuries	**0**	**1**	**1**	**2**
Choroid rupture	0	1	0	1
Oculomotor nerve laceration	0	0	1	1
Retinal Injuries	**0**	**2**	**0**	**2**
Retina detachment	0	2	0	2
Vitreouse Injuries	**1**	**1**	**0**	**2**
Vitreous detachment	0	1	0	1
Vitreous hemorrhage	1	0	0	1
Total Injuries	**94**	**223**	**58**	**375**

Anatomy of the eye



Conclusions

- This analysis demonstrated the severity of ocular injuries treated by far forward surgical units in Afghanistan.
- Within our dataset, approximately 27% of injuries were predicted to have significant and permanent loss of vision.
- Almost 1/3 of injuries likely/possibly resulted in vision loss.
- Although infrequent, severe ocular injuries occurred in the battlefield.
- This study should be used to guide clinically-relevant research and training and to resource medical assets on the battlefield.

Acknowledgements

This work was supported by the Assistant Secretary of Defense for Health Affairs through the Defense Medical Research and Development Program under Award No. W81XWH-15-2-0085. Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the Department of Defense. The authors acknowledge the Joint Trauma System Role 2 Database for providing data for this study

Statements

This study was conducted under a protocol reviewed and approved by the US Army Institute of Surgical Research Regulatory Compliance Division and in accordance with the approved protocol.

A REVIEW OF CASUALTIES THAT UNDERWENT PAIN MANAGEMENT BEFORE REACHING ROLE 2 IN AFGHANISTAN

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The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

Introduction

- Analgesia choice is a key early decision made by casualty care providers.
- First, do no harm – minimizing iatrogenic resuscitative burden is an ethical mandate.
- Significant differences have been found in blood pressure of combat casualties following different analgesic choices.[1]
- Balancing sustained combat lethality against proper analgesia will be a concern for the future warfighter.[2]
- Prehospital data is lacking, and hampers potential research efforts to improving care in the early, highest-leverage minutes.[3]
- The Role 2 Database (R2D) is the largest existing modern wartime prehospital database, and may offer valuable insights on these issues.[4]

Objectives

- Examine relationships between analgesic administration and other patient characteristics, particularly mortality and injury severity
- Identify attributes significantly associated with missing vital sign data in the prehospital environment

Methods

- De-identified retrospective review of R2D
  - Inclusion: adult patients injured in Afghanistan
  - Exclusion: patients who sustained isolated disease or mental health/psychiatric diagnoses
- Primary interests were mortality and analgesic administration.
  - Morphine
  - Fentanyl
  - Ketamine
  - NSAIDs
- Other variables included
  - Demographics (e.g., age, nationality)
  - Prehospital Combat mortality index (CMI)[5] (Figure 1)
  - Vital signs
  - Time of transport
- Additional analysis was performed to identify patterns related to missing prehospital data.
  - Prehospital data were construed as missing if all vital signs were absent in the record: blood pressure, pulse, oxygen saturation and temperature.
- Data were analyzed using chi-square, Fisher's Exact, Mantel-Haenzel (M-H), Kruskal-Wallis, or Cochrane-Armitage as appropriate.

Figure 1. Prehospital Combat mortality index (CMI) is a measure of physiological injury severity that uses clinical variables of heart rate (HR), systolic blood pressure (SBP), and Glasgow coma score (GCS) to develop a score ranging from 0 to 4

Results

Table 1: Demographics of study patients with (n=1,084) and without (n=11,696) documented analgesia.

	Total, n (%)	Analgesia, n (%)	No analgesia, n (%)
Patient Affiliation*			
US Forces	4,667 (36.5)	431 (39.8)	4,236 (36.2)
Non-US Military	4,933 (38.6)	432 (39.9)	4,501 (38.5)
Other	3,180 (24.9)	221 (20.4)	2,959 (25.3)
Category of Injury*			
Battle Injury	9,733 (76.2)	880 (81.2)	8,986 (75.7)
Non-Battle Injury	3,047 (23.8)	204 (18.8)	2,913 (24.3)
Prehospital CMI[a]			
Mild	7,003 (54.8)	639 (9.1)	6,364 (54.4)
Moderate	2,941 (23.0)	253 (8.6)	2,688 (23.0)
Severe	747 (5.9)	69 (9.2)	678 (6.6)
Critical	537 (4.2)	31 (5.8)	506 (4.9)
Unknown	1,552 (12.1)	92 (15.6)	1,460 (12.5)
Outcome			
Alive - RTD	4,498 (35.2)	288 (26.6)	4,210 (36.0)
Alive - Transported	7,321 (57.3)	771 (71.1)	6,550 (56.0)
Dead	920 (7.2)	25 (2.3)	895 (7.7)
Unknown	41 (0.3)	0 (0.0)	41 (0.03)

Abbreviations: CMI, Combat Mortality Index ; RTD, Returned to Duty
[a]Prehospital combat mortality index was calculated using prehospital vital signs, or initial vital signs on presentation to Role 2.

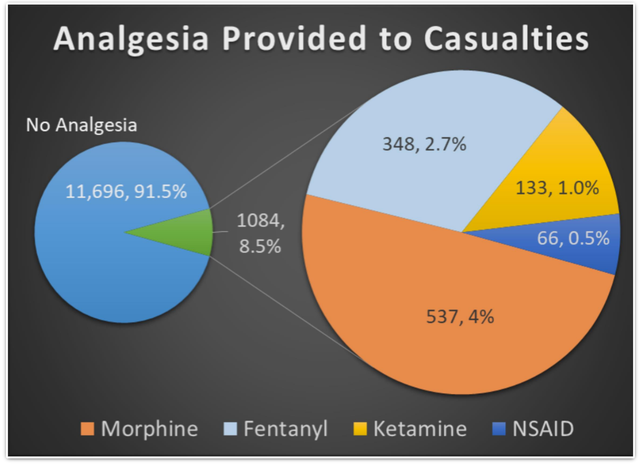

Figure 2. Numbers and percentages of documented pain medications provided to casualties

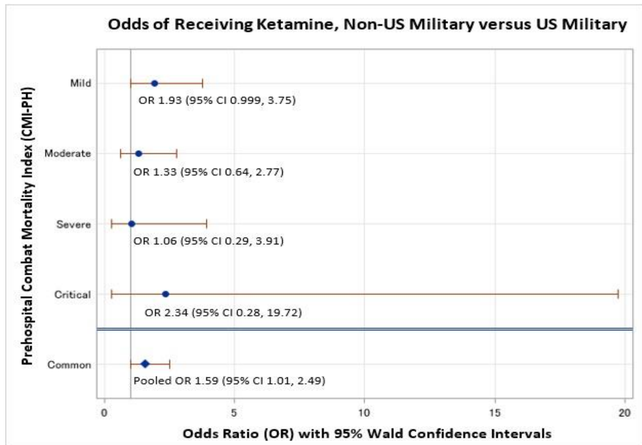

Figure 3. M-H pooled odds comparison, Non-US military versus US Military receiving ketamine

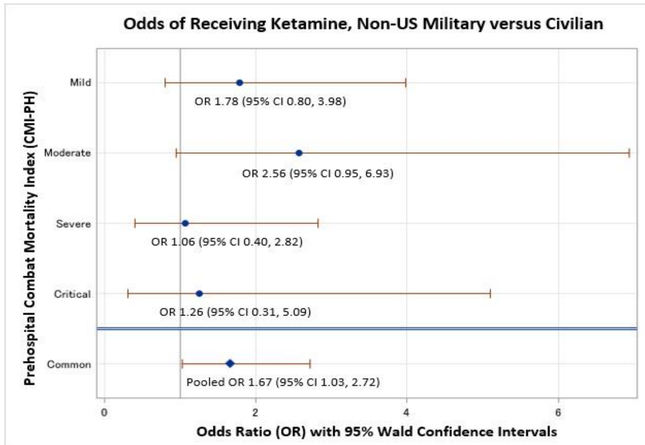

Figure 4. M-H pooled odds comparison, Non-US military versus Civilian receiving ketamine

Table 2: Prehospital/arrival vital signs by analgesic group

	Total (n= 1,084)	NSAID (n=66, 6.1%)	Morphine (n=537, 49.5%)	Fentanyl (n=348, 32.1%)	Ketamine (n=133, 12.3%)
Vital Signs, median [IQR]					
SBP (mmHg)	131 [117-142]	134.5 [128-141]	131 [118-143]	131 [116-141]	129 [114-144]
Unassisted Respiratory Rate (RPM)	18 [16-22]	18 [16-20]	18 [16-22]	19 [16-22]	18 [16-23]
Pulse (BPM)*	89 [77-104]	80 [72-94]	88 [77-102]	90 [78-107]	98 [82-117]
O_2 Saturation (%)	98 [96-100]	97 [96-99]	98 [96-100]	98 [97-100]	99 [96-100]
Temperature (°F)	98.2 [97.5-98.8]	98.2 [97.6-98.6]	98.2 [97.5-98.8]	98.2 [97.5-98.9]	98.0 [97.2-98.8]

Abbreviations: IQR, Intraquartile range; RPM, respirations per minute; BPM, beats per minute *Significant at <0.05 level

- Of 12,780 casualties included in this study, 1,084 (8.5%) received documented analgesia.
- Casualties who received analgesia were generally male (98.2%) with a median age of 25 (IQR 21-30).
- Mortality, injury mechanism, CMI-PH and national affiliation were significantly associated with missing prehospital vital sign data.
- Time of transport and sex were not associated.

Conclusions

- In the R2D, patients had fewer documented administrations of analgesia as physiological severity increased.
  - Increased resuscitative needs may preclude administration or documentation.
  - Very few patients who ultimately died had documented analgesia (2.7% of 920 deaths).
  - As such, analgesia was significantly associated with survival.
- Non-US military patients had increased odds of receiving ketamine versus US military or civilians when controlling for overall physiological status
  - Unknown first responder, possible non-US; may simply reflect foreign practice patterns/guidelines
- Most vital signs were similar between anesthesia groups
  - Ketamine group had higher median pulse, consistent with shock indication and sympathomimetic effects
- Patients had fewer documented prehospital vital signs as physiological severity increased
  - Hampers performance improvement and research efforts
  - Deficit calls for a means to automate prehospital vital sign collection

Acknowledgements

- The authors acknowledge the Joint Trauma System R2D for providing data for this study.
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Patient injury patterns and procedural burden experienced by U.S. military Role 2 forward surgical teams in Afghanistan

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Disclaimer

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This study was reviewed and approved by the U.S. Army Institute of Surgical Research institutional regulatory department and was determined to be exempt from Institutional Review Board.

Background

Evaluation of role 2 (R2) medical resources in the Afghanistan combat theater: Initial review of the joint trauma system R2 registry

Elizabeth A. Mann-Salinas, PhD, RN, Tuan D. Le, MD, DrPH, Stacy A. Shackelford, MD, Jeffrey A. Bailey, MD, Zsolt T. Stockinger, MD, Mary Ann Spott, PhD, Michael D. Wirt, MD, PhD, Rory Rickard, PhD, FRCS, Ian B. Lane, BDS, MPH, Timothy Hodgetts, PhD, FRCP, Sylvain Cardin, PhD, Kyle N. Remick, MD, *and* Kirby R. Gross, MD, *San Antonio, Texas*

Combat surgical workload in Operation Iraqi Freedom and Operation Enduring Freedom: The definitive analysis

Caryn A. Turner, MPH, Zsolt T. Stockinger, MD, *and* Jennifer M. Gurney, MD, FACS, *Fort Sam Houston, Texas*

Original Investigation

Use of National Burden to Define Operative Emergency General Surgery

JAMA Surg. 2016;151(6):e160480. doi:10.1001/jamasurg.2016.0480

John W. Scott, MD, MPH; Olubode A. Olufajo, MD, MPH; Gabriel A. Brat, MD; John A. Rose, MD, MPH; Cheryl K. Zogg, MSPH, MHS; Adil H. Haider, MD, MPH; Ali Salim, MD; Joaquim M. Havens, MD

(Incorporated Scott's methodology)

Objectives

Among battle and non-battle injured casualties treated at Role 2 facilities in Afghanistan:

- Describe the injuries
- Calculate procedural burden received by casualties

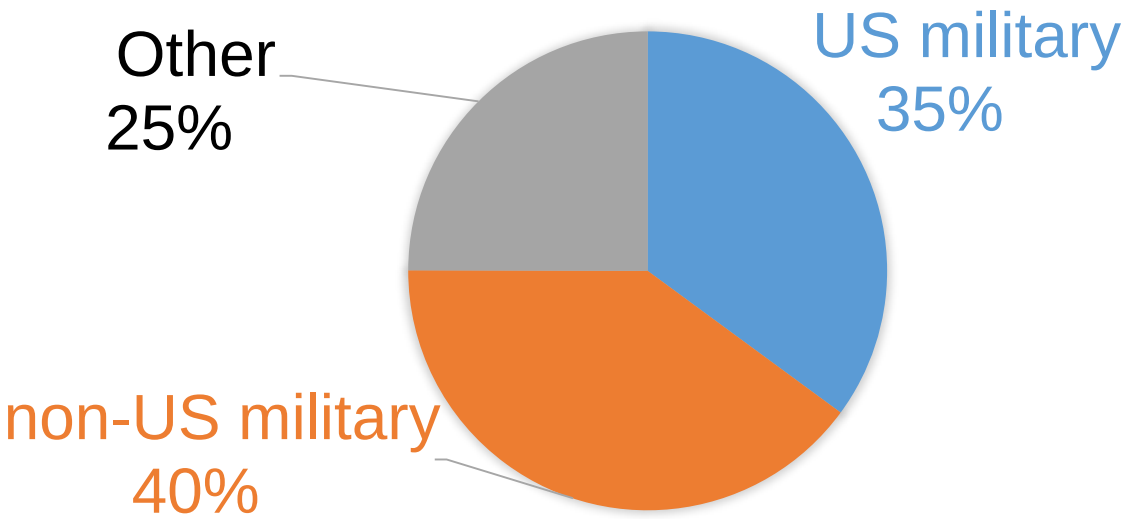
Weight procedures by frequency, mortality, and morbidity

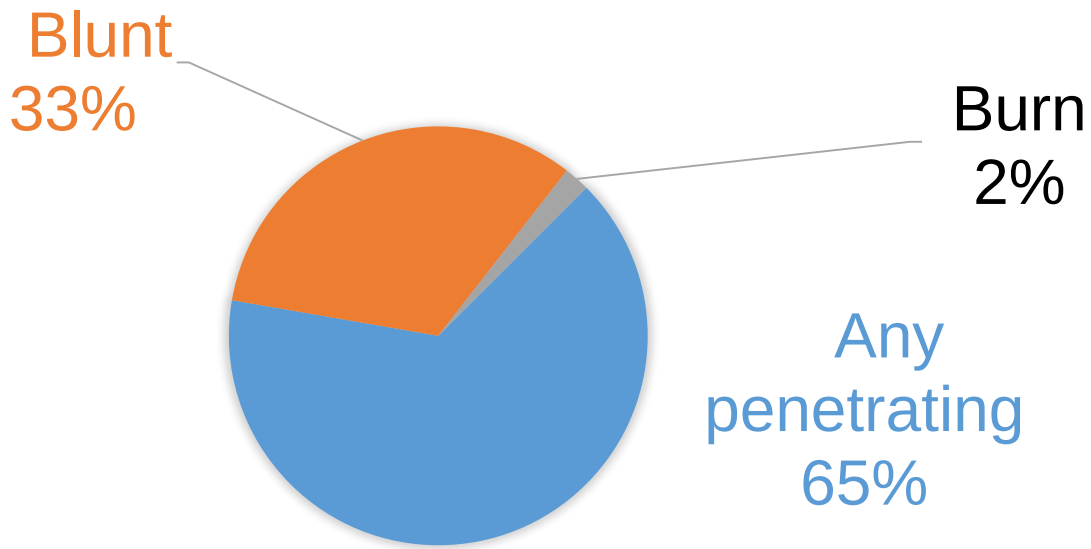
Data sources

- Secondary data analysis
- Retrospective study
- Role 2 Database
  - Abbreviated Injury Scale (AIS) _ _ _ _ _ _ _ . _
  - International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)
- Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software categorization scheme

Study population, n = 10,992

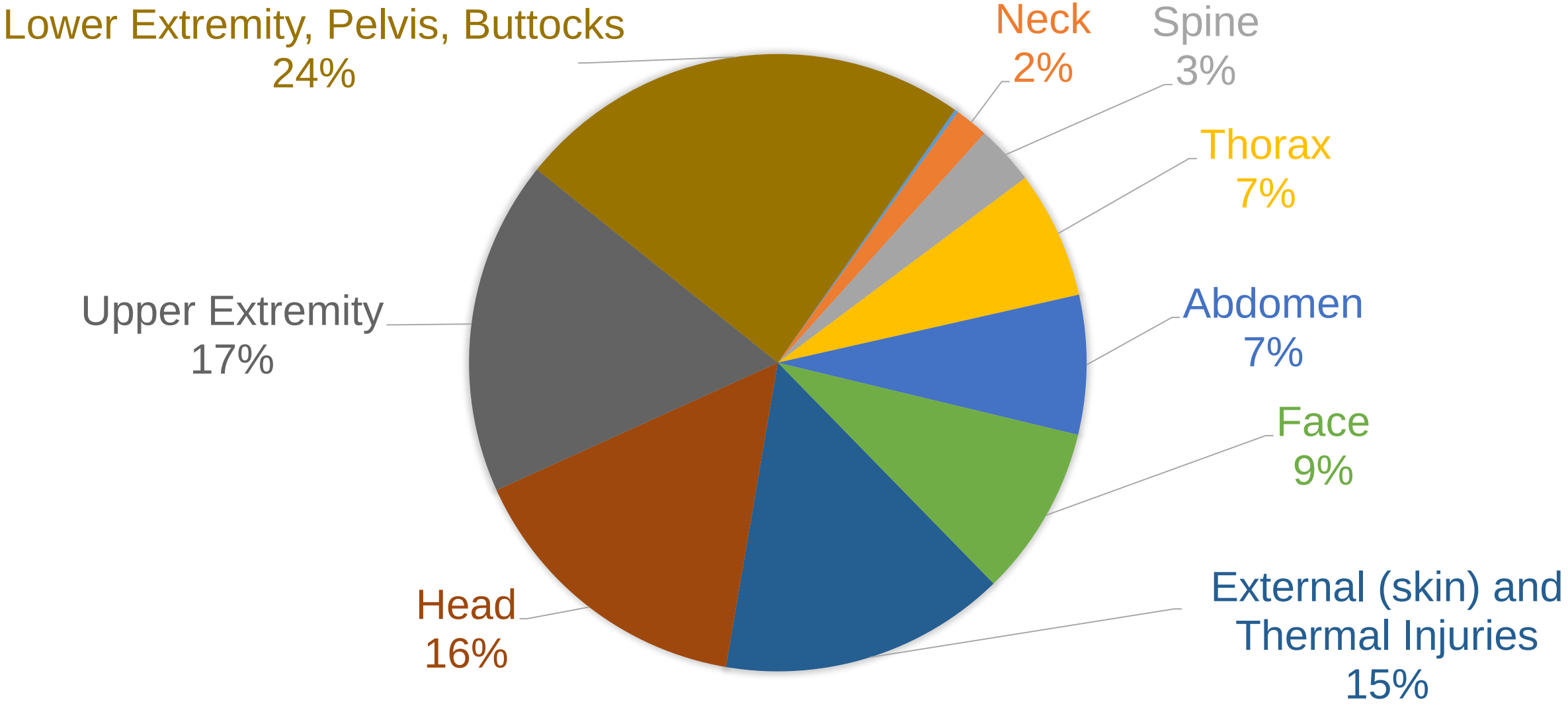
- Adult
- Surgical Role 2 patients
- Battle or non-battle injured
- Afghanistan
- February 2008 to September 2014



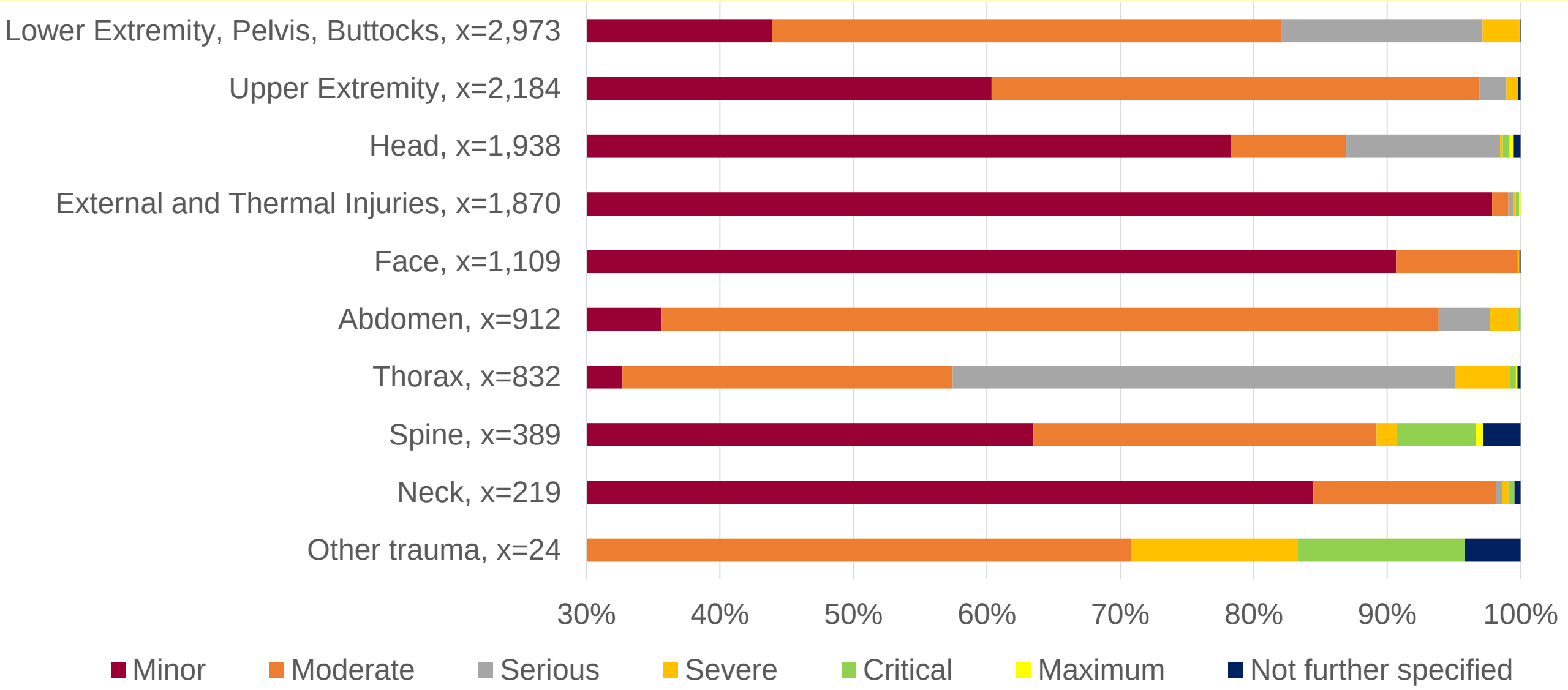


- Documented injury (x = 12,450)
- Procedures (x = 27,251)
- 97.8% male
- Median (IQR) age = 25 (22-30)
- Median (IQR) ISS = 2 (1, 5)
- Mortality = 4.4%

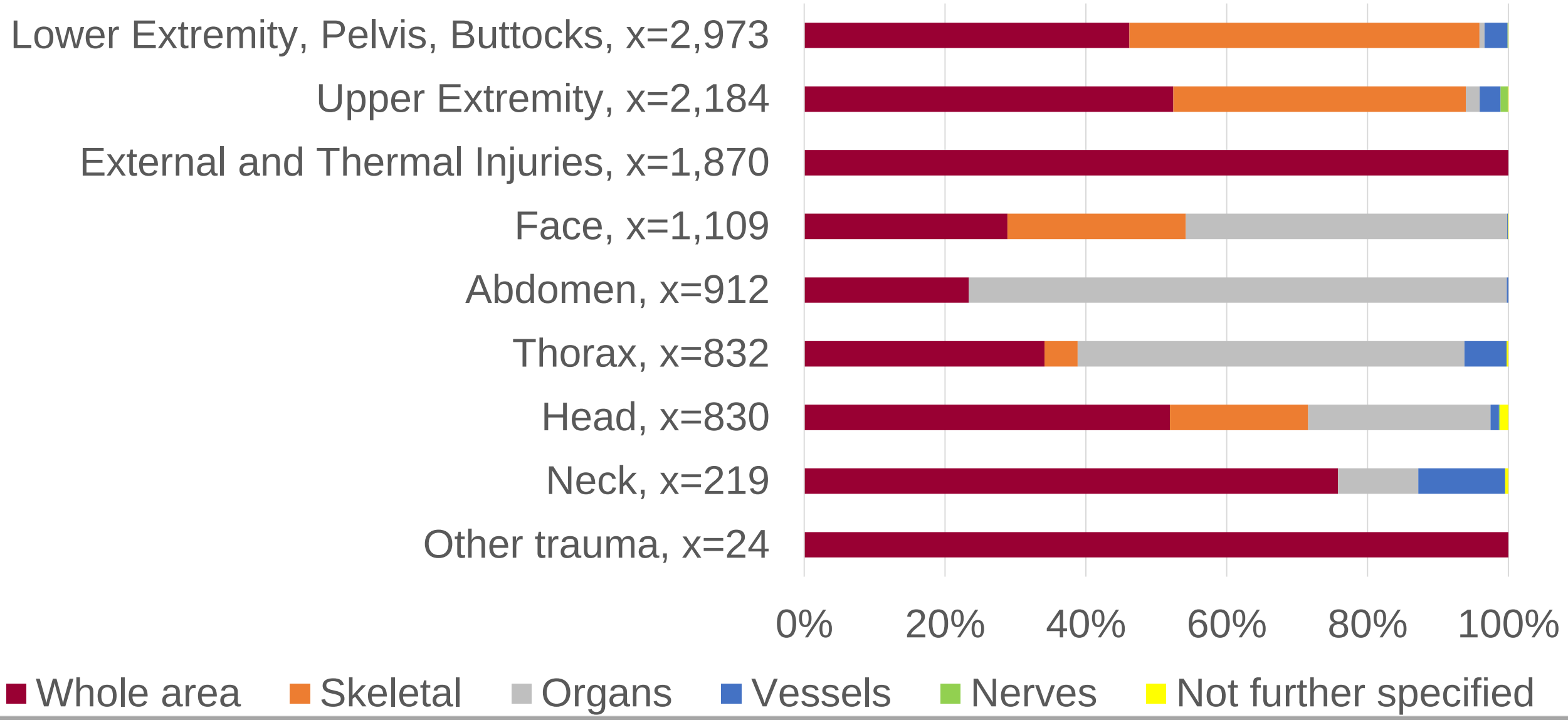
Injured body region



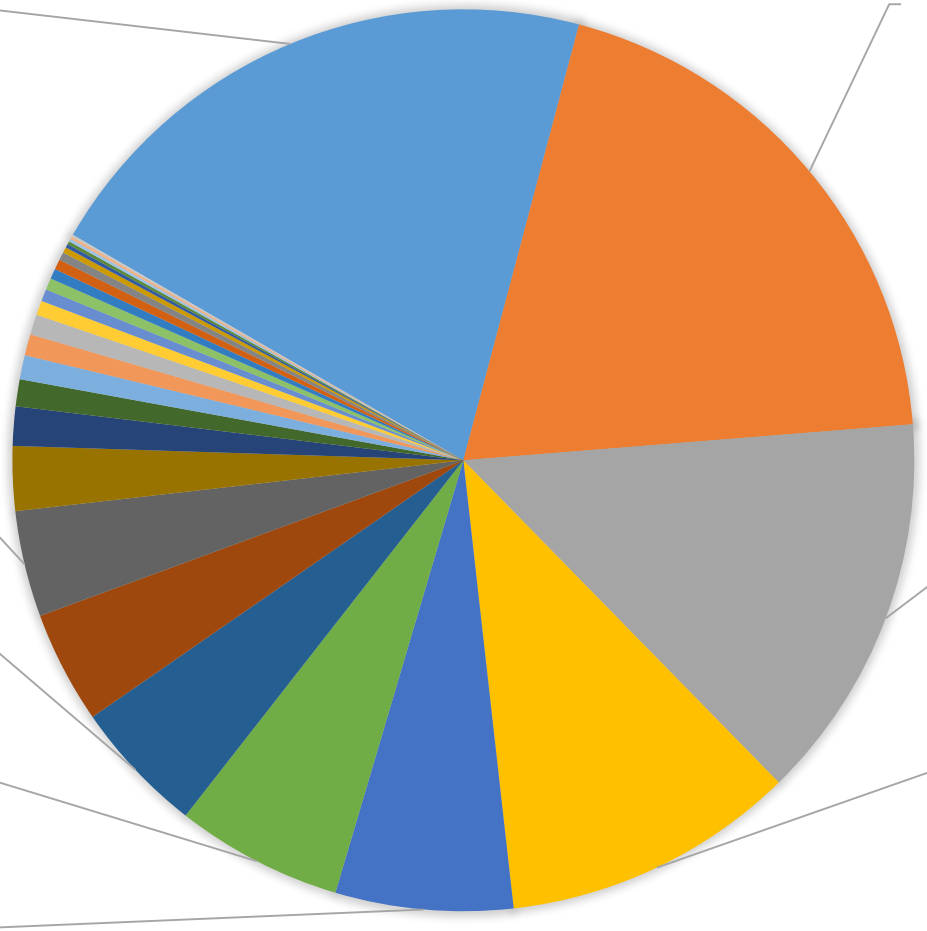
Body region by severity (x = 12,450)



Body region by anatomic structure (x=10,953)

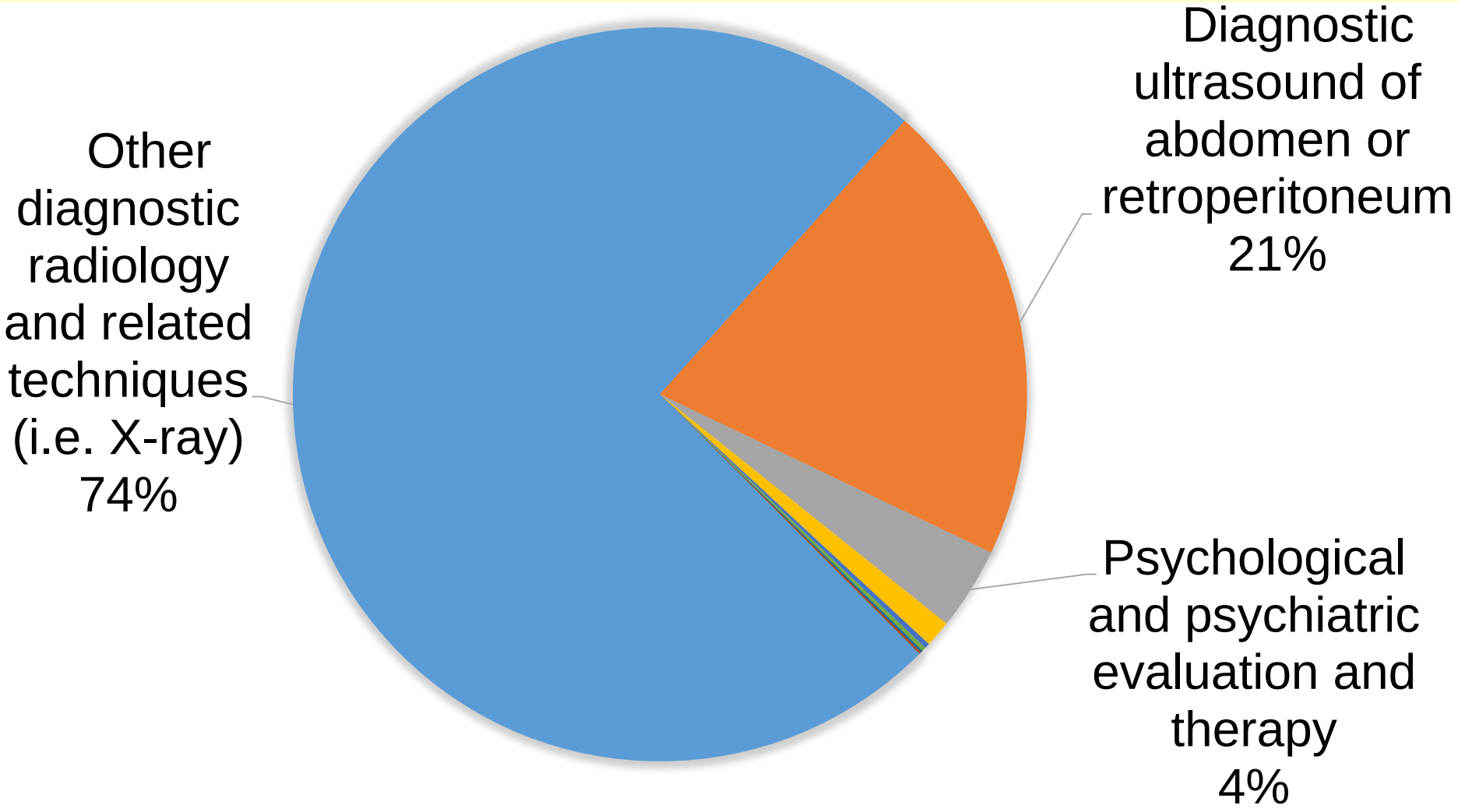


Non-operative therapeutic procedures



Note: non-operative therapeutic procedures were not included in operative procedural burden calculations

Non-operative diagnostic procedures



Note: non-operative diagnostic procedures were not included in operative procedural burden calculations

Morbidity (n = 1,632)

- 14.9% of study population

- Top 3
  - Hypothermia (n = 866)
  - Anemia/Blood loss (n = 685)
  - Hypovolemia (n = 260)

Burden calculation

- John Scott's Methodology in JAMA Surg 2016 manuscript on civilian Emergency General Surgery

- HCUP operative procedure groups were weighted by injury by frequency of procedure, mortality, and morbidity

$$Rank_{burden} = Rank_{mortality}\left(\%_{mortality} \times n_{procedure}\right) + Rank_{morbidity}\left(\%_{morbidity} \times n_{procedure}\right)$$

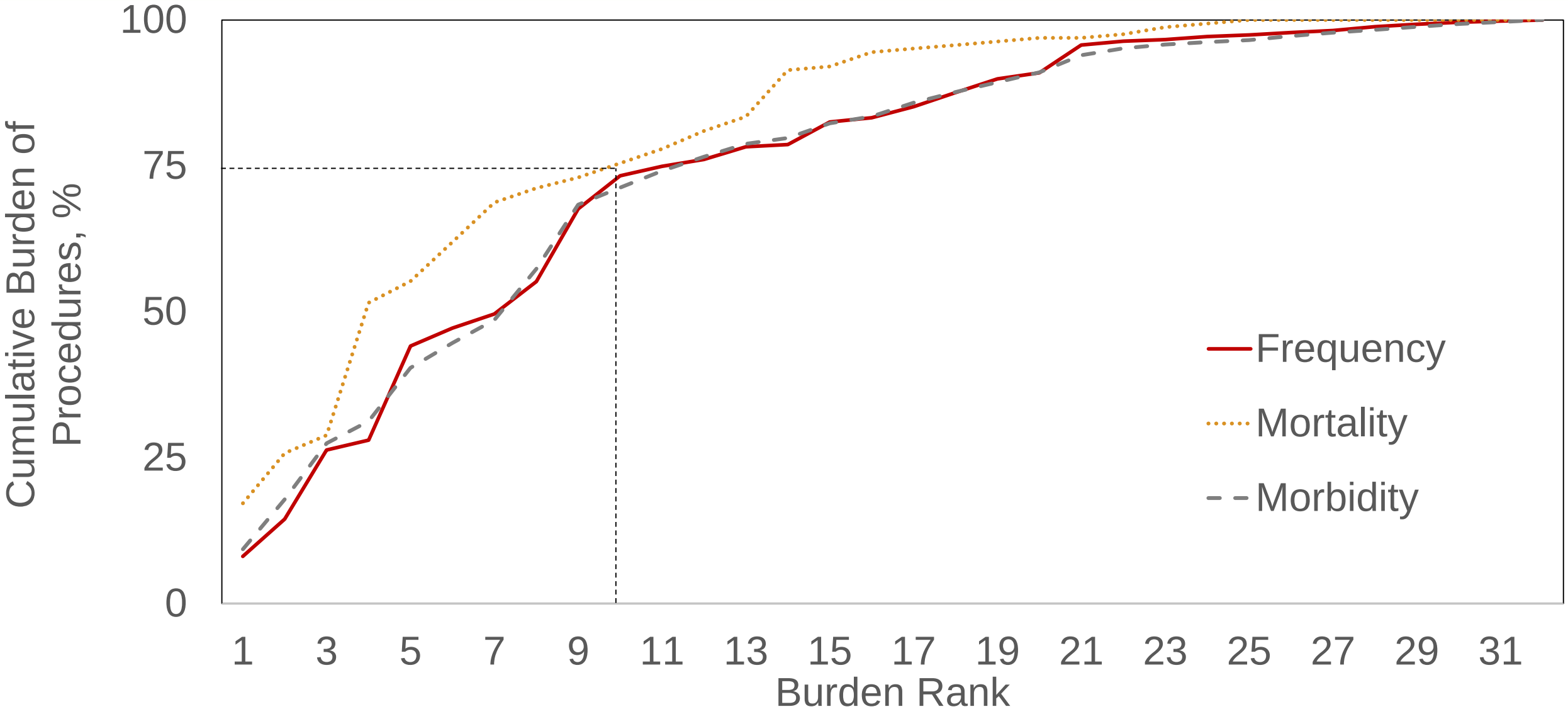
- Cumulative burden by procedure group

Frequency of procedure: $\frac{\sum_{i_{procedure}}^{n=3,573} i}{n} \times 100$

Mortality: $\frac{\sum_{i_{mortality}}^{n=163} i}{n} \times 100$

Morbidity: $\frac{\sum_{i_{morbidity}}^{n=1,191} i}{n} \times 100$

Cumulative burden of procedures by burden rank



~75% of cumulative procedural burden

- Non-therapeutic exploratory laparotomy
- Vascular procedures other than head and neck
- External fixation
- Debridement
- Resection, Repair, Suture, or incision of large or small intestine, duodenum, or colon
- Amputation of lower extremity
- Suture of liver, abdominal wall, pancreas, or omentum; Laparotomy NEC; Pancreatectomy; Groin Exploration
- Therapeutic procedures on muscles and tendons
- Debridement of open fracture, internal fixation, or reduction to lower extremity (other than hip or femur)
- Thoracotomy

Limitations

- No follow-up data
- Database not validated against medical records
- Convenience sampling
- No data on injuries not treated

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How should we use this information?

- Focus pre-deployment training programs on these common and complex skill sets
- Inform surgical benchmarks for Role 2s
- Resource medical assets at Role 2 facilities in similar operational environments
- Support for additional research to improve the surgical procedures with the greatest burden

Future efforts

- Continue data collection (including long-term follow-up) in austere environments to support future research efforts

- Consider both frequency and severity of illness/injury to determine the greatest burden to readiness for the military health system

Acknowledgements

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- COL Russ S. Kotwal, MC, USA, (Ret.)
- LTC Christopher A. VanFosson, ANC, USA

Development of a Standardized Competency Program for Combat Medical Readiness

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LTC Christopher VanFosson[1], COL Booker King[2], COL (Ret.) Elizabeth Mann-Salinas[1], [1]US Army Institute of Surgical Research; [2]Womack Army Medical Center,

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Introduction/Background

- **There is currently no standard program for clinical pre-deployment readiness, nor documentation tool of individual competency and training.**
- The 2017 National Defense Authorization Act included a requirement to establish a standardized training curriculum for pre-deployment training and to formally partner with civilian trauma centers to ensure military clinicians are exposed the volume and acuity of trauma and burn patients.
- USAISR/BAMC has been established as a premier military readiness platform at DoD's only Level I Trauma and Burn Center. Preliminary results from this pilot have reflected self reported improvements on key skills.
- From Jan. 2015-Sept. 2018 a total of 229 personnel have rotated through the USAISR program.
- Standardized training curriculum in development with the following goals:
  - -Nursing content for Knowledge/Skills/Abilities (KSA) competency development and assessment
  - -Documentation tools for nursing combat readiness
  - -Knowledge assessment test (Nursing, Medic, Tech, Corpsmen) and novel training platforms (gaming)
  - -Simulation scenarios that are easily replicated
  - -Standardized curriculum exportable to a civilian facility

Objectives

- Demonstrate that a comprehensive platform to prepare providers for combat deployment is improved with implementation of a standardized program.
- Aim 1: Create standardized training and sustainment modules for identified combat related skills.
- Aim 2: Demonstrate that a program created for the Burn/Trauma Center is adaptable across the Military Health System (MHS) and Civilian partners.

Methods

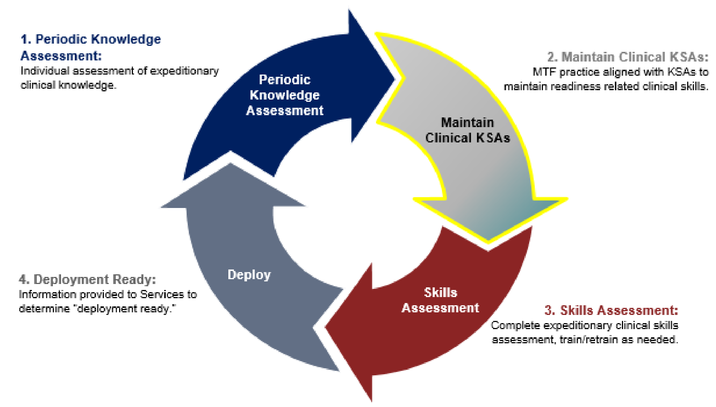
A prospective, cohort project to compare the observed skill and knowledge of combat casualty care (CCC) for nurses/medics/corpsmen/technicians expected to deploy.
Objective metrics:

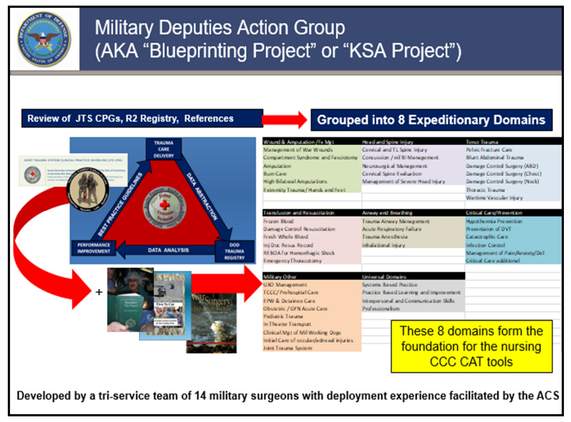
✓ Readiness Estimate and Deployability Index (READI) and Periodic Evaluation Tool (PET) instrument will be used for self assessment

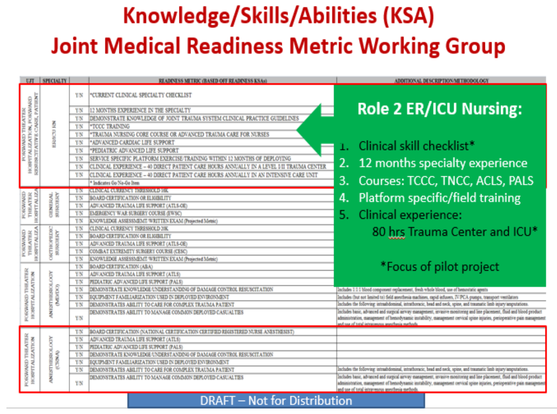
✓ CCC Competency Assessment Tool will be used to evaluate and document clinical skills and patient care hours

Each group was assessed using the aforementioned tools and categorized into two groups: those who received no simulation training and those who did.

Methods







USAISR/BAMC Pre-deployment Program

Pre-deployers
- -Forward Resuscitative Surgical Teams
- -Hospital Centers
- -Individuals

Duration
- 1-4 week rotation

Location
- Burn Center and Emergency Department

Goals
- Clinical experience, burn knowledge
- Documentation of competency in CCC

USAISR Burn Center Clinical Pre-Deployment Training Program Components

Didactic Content*

Advanced Burn Life Support Course
Thermal Injuries I & II
Fluid Resuscitation
Inhalation Injury
Prolonged Care & Burn CPG
Burn Sepsis
Infection Control
Don't get burned by drugs
Wound Care Foundation
Patient Packaging/Transport
JTS Teleconference
*CEUs available

Simulation Scenarios

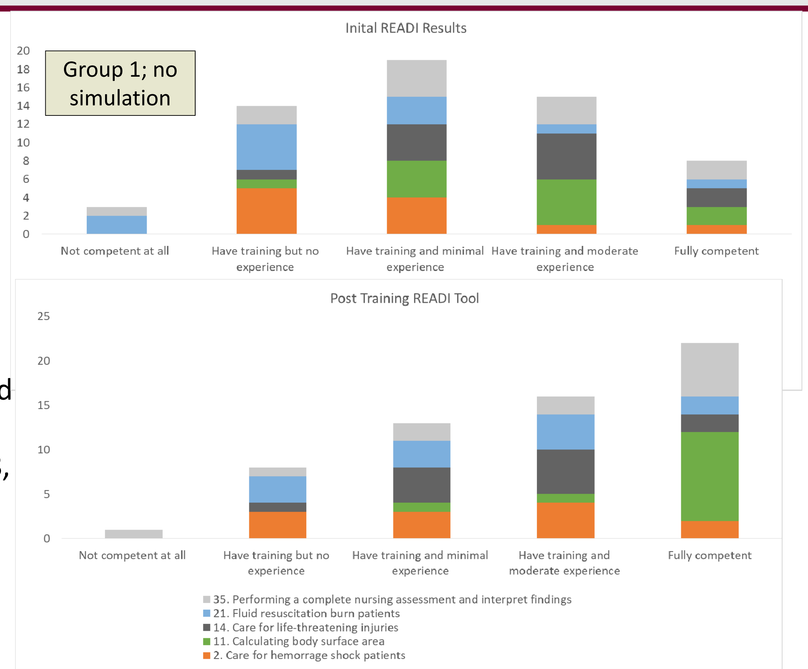
Initial burn management
Pediatric trauma care
Management of poly-trauma patient
- Non-compressible torso hemorrhage
- Fresh whole blood collection & administration
- Management of traumatic brain injury

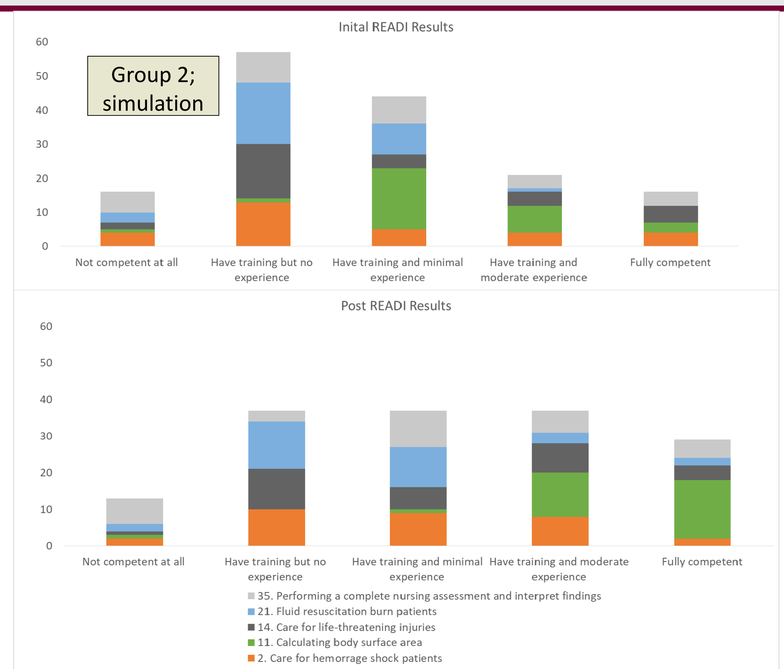
Preparation of patient for transport
- Burn Flight Team scenarios
- Equipment:
  Field ventilator, infusion pump, lab

Preliminary Results

Demographics

- 42 total: 18 Female, 28 Male
- Average age 26-30
- All assigned to field units with 28/42 having deployed previously in current role
- 40/42 have conducted field training in the last year
- Specialties: CRNA=1, RN=8, LPN= 17, medic=10, surgical tech=3, other=3





Summary/Future Implications

- Upon completion of training, both groups reported improved competence on critical elements.
- USAISR/BAMC collaboration will optimize assets of both organizations.
- Project is directly aligned with Defense Health Agency aims through the KSA Project and 8 domains of Combat Casualty Care.
- Pilot project will result in a program that is standardized, exportable, and offers clear documentation of required readiness elements.
- Efforts underway to maximize efficiency of documentation using available electronic resources (e.g., Elsevier Clinical Skills Learning Management System) and add Knowledge assessment test to assess understanding of Clinical Practice Guidelines and CCC concepts.
- Civilian centers could replicate this training platform for community partners to facilitate hands-on experience in preparation for real world civilian mass casualty.

Acknowledgements

This work was supported by the Assistant Secretary of Defense for Health Affairs through the Defense Medical Research and Development Program under Award No.W81XWH-15-2-0085 and the US Army Combat Casualty Care Research Program RAD 2 - A3_061_2017_USAISR
Photo Credit: Dr Steven Galvan, USAISR PAO

An Assessment of Pre-deployment Training of Army Nurses and Medics

LTC Christopher A. VanFosson, PhD, MHA, RN; Jennifer D. Trevino, MBA; Amanda M. Staudt, PhD, MPH;
Mithun R. Suresh, MD; Krystal K. Valdez-Delgado, BSN, RN; Tricia L. Garcia-Choudary, MPH, BSN, RN;
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Background

- Clinicians face several challenges when caring for trauma patients on the battlefield. Combat casualty care may include:
  - Treating patients while under attack
  - Resource constraints
  - Periods of limited visibility/darkness
  - Rugged terrain
  - Extreme temperatures
- Therefore, optimal preparation for clinicians includes exposure to as many combat trauma situations as possible prior to deployment
- Army nurses and combat medics undergo a wide variety of pre-deployment training events
- The literature contains no evaluation of Army nurse or combat medic pre-deployment training

Objectives

The purpose of this study was to survey trauma care-oriented Army nurses and combat medics to describe the range of pre-deployment trainings they experienced in order to provide guidance on future pre-deployment training requirements

Methods

- Survey link sent to military email accounts provided by US Army Human Resource Command
  - Army nurses from active (n=2,344) and reserve (n=2,458) components
  - Active duty combat medics (n=17,535)
- Inclusion criteria:
  - Deployed to a combat theater since 2001
  - Registered nurse (medical-surgical, emergency, critical care), certified registered nurse anesthetist (CRNA), or medic (technician or licensed vocational nurse)
- Intelink.gov survey platform
  - Targeted up to two most recent deployments
  - Captured demographic information, deployment history, and military training received prior to deployment
- Three monthly reminder emails sent to all potential participants
- Survey data analyzed using descriptive statistics

Results

- Of 22,337 emails sent, there were 1,181 respondents (5.3% response rate); 696 (58.9% of respondents) met inclusion criteria

Characteristics of the Participants	n	%
Total Participants	696	100.0
Male	517	74.3
Age		
18 - 24 years	95	13.6
25 - 34 years	329	47.3
35 - 44 years	204	29.3
45 - 54 years	64	9.2
55 - 64 years	4	0.6
Rank		
E-1 to E-4	137	19.7
E-5 to E-6	264	37.9
E-7 to E-9	66	9.5
O-1 to O-3	140	20.1
O-4 to O-6	89	12.8
Active Duty	644	92.5
Area of Concentration or Military Operational Specialty		
Combat Medic	382	54.9
Critical Care Nurse	62	8.9
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Other	35	5.0
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1	269	38.6
2	212	30.5
3	115	16.5
4	58	8.3
5 or more	42	6.0
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Africa	13	1.9
Iraq	198	28.4
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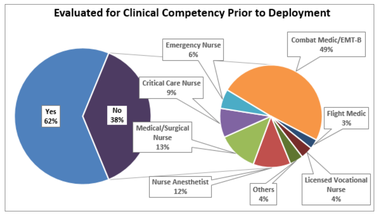
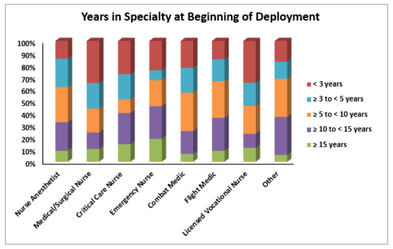
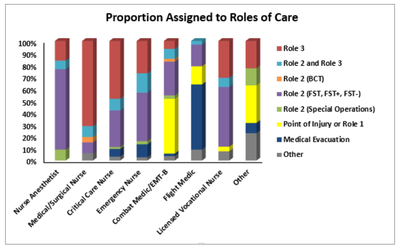
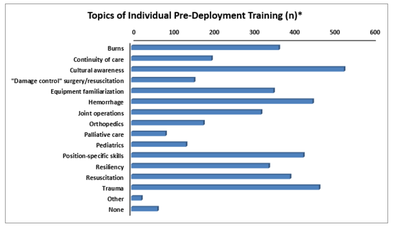
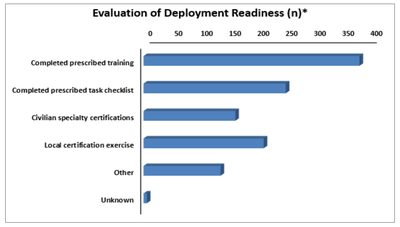
Kuwait	59	8.5
Syria	17	2.4
Other area (Middle East)	18	2.6
Other area (global)	20	2.9

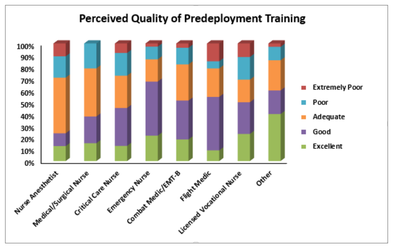


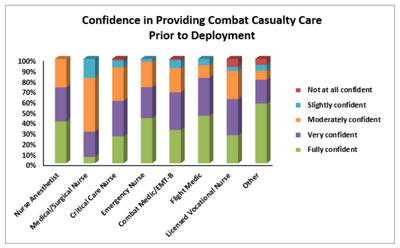


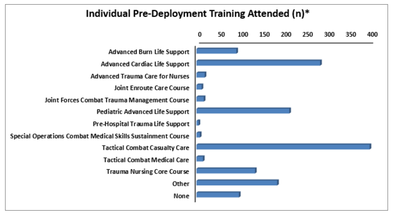


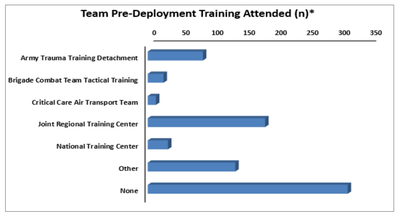


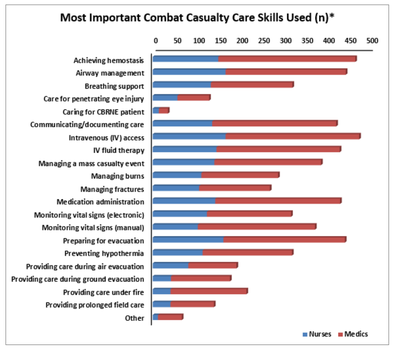


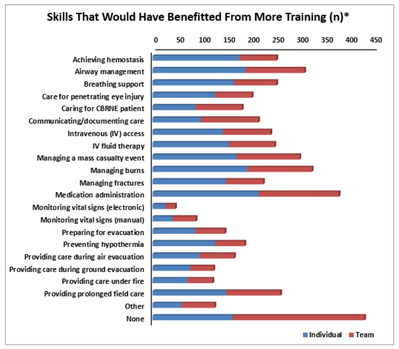












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- Most nurses and medics were satisfied with the quality of their pre-deployment training (when it occurred)
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- Army nurses and medics felt confident and adequately trained to provide trauma care during their deployments. This study is ongoing. Further analysis of the complete data will inform Army Medical Department leaders about pre-deployment training for Army nurses and medics, as well as the respondents' views of the effectiveness of this training.

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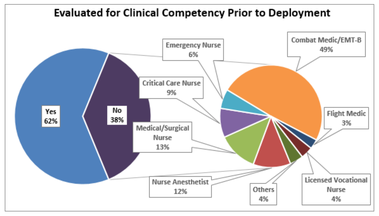

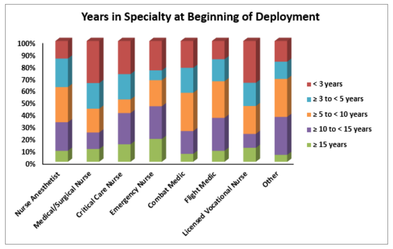

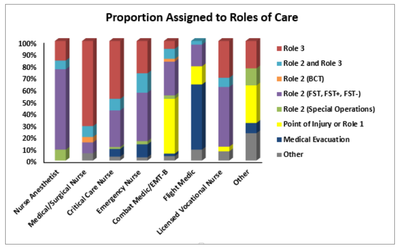

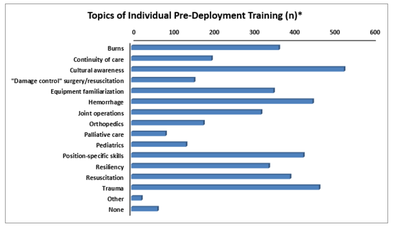

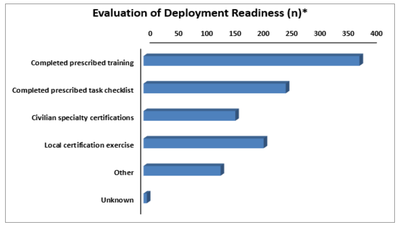

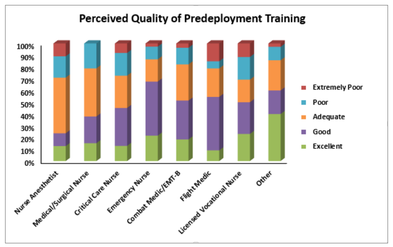

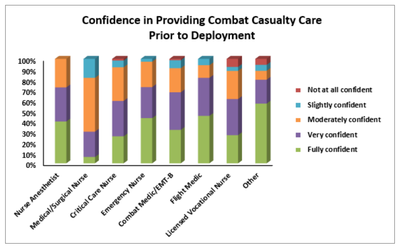

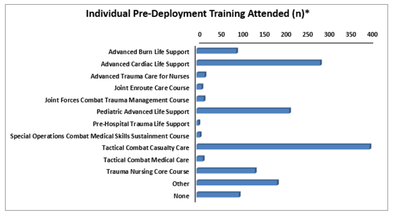

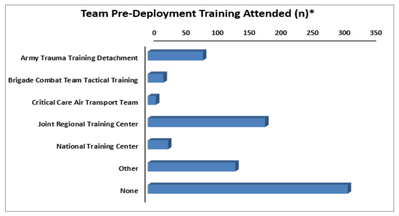

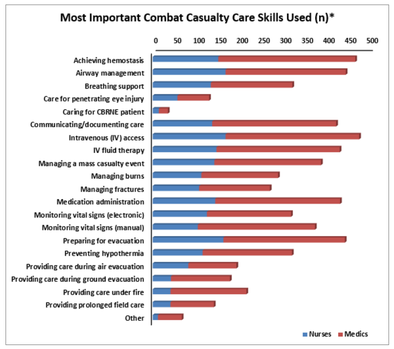

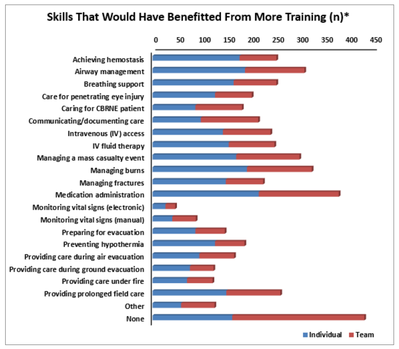

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Objective

To survey trauma care-oriented Army nurses (RNs and LVNs) and combat medics to describe the range of pre-deployment trainings they experienced in order to provide guidance on future pre-deployment training requirements

Methods

- Survey method
  - Approved by IRB (exempt) and ARL
  - Intelink.gov survey platform
  - Questions based on READI tool[3]
- Link sent to military email accounts
  - Army nurses from active (n=2,344) and reserve (n=2,458) components
  - Active duty combat medics (n=17,535)
- 3 monthly reminders
- Targeted up to 2 most recent deployments

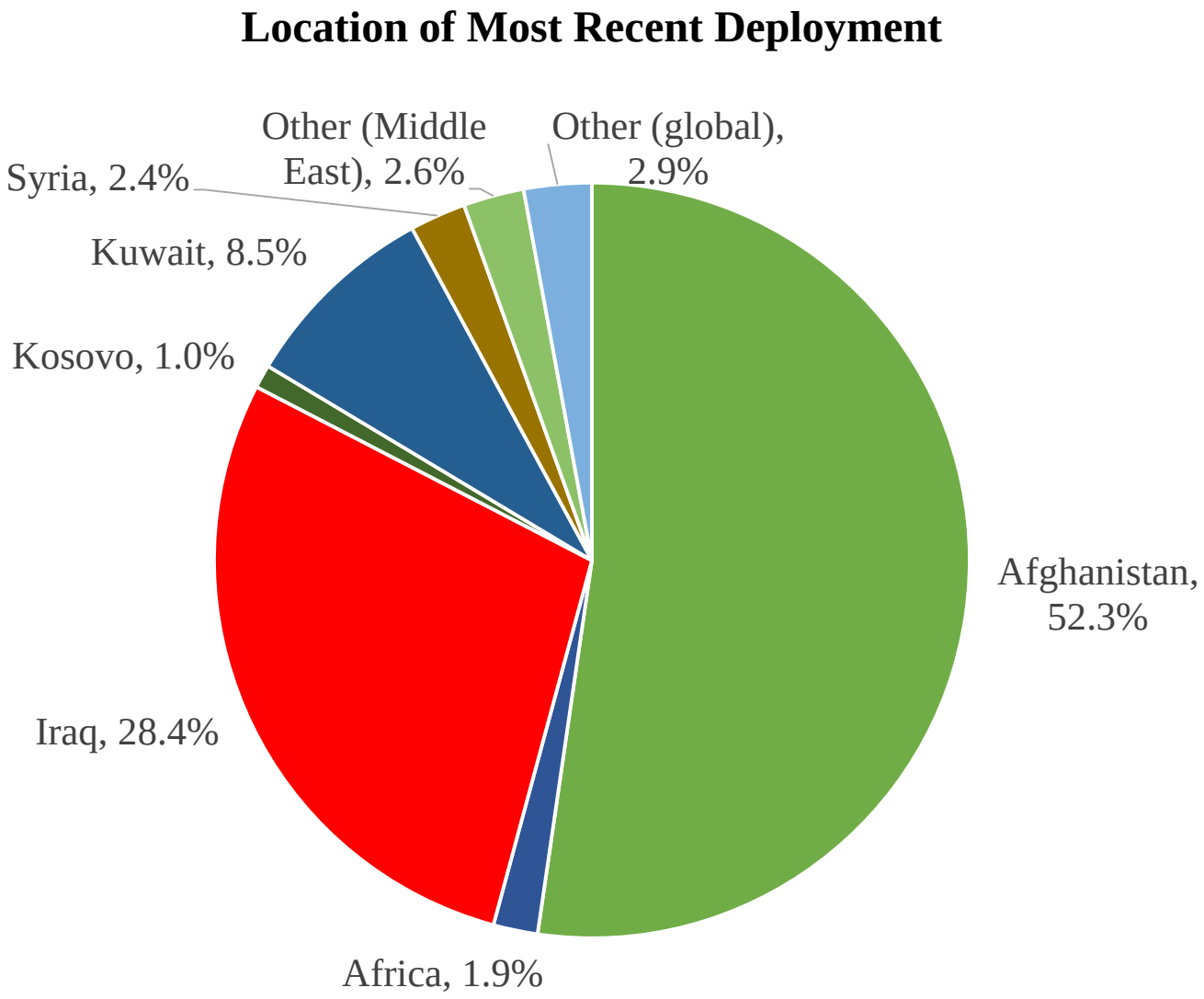
Methods

- Inclusion criteria:
  - Deployed to combat theater since 2001
  - Registered nurse or medic
    - Medical/surgical nurse
    - Emergency nurse
    - Critical care nurse
    - Nurse anesthetist
    - Licensed vocational nurse
    - Combat medic (or variants)

Results

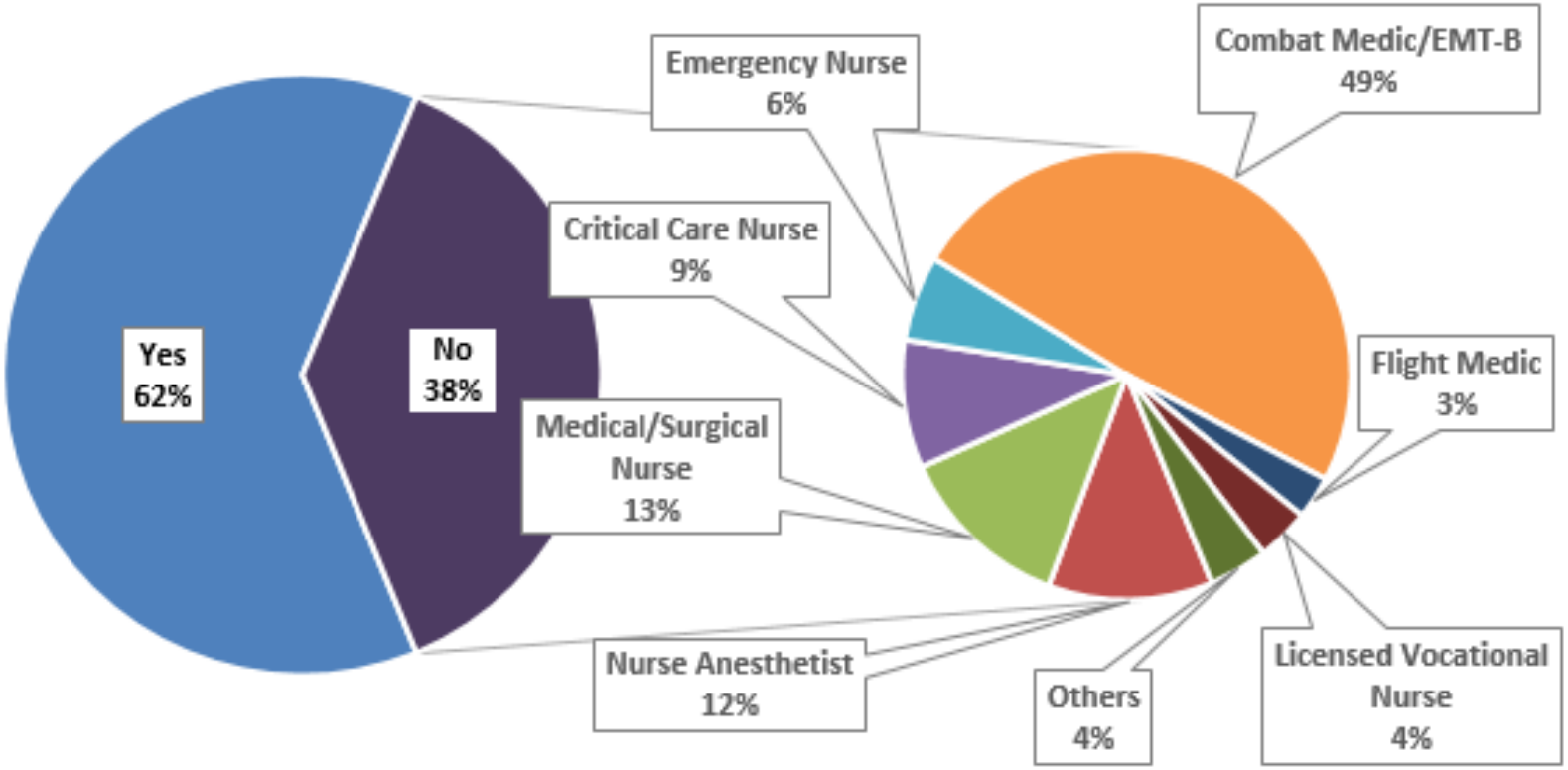
- 22,337 initial emails sent
  - 1,181 respondents (5.3% response rate)
  - 696 met inclusion criteria (58.9% of respondents)
- 73.4% (n=511) male
- 91.1% (n=634) active duty
- 45.1% (n=314) officers (Army Nurse Corps)
- Multiple deployments
  - 61.2% had 2 or more
  - 14.2% had 4 or more

Results


Location of Most Recent Deployment
Other (Middle East), 2.6%
Other (global), 2.9%
Syria, 2.4%
Kuwait, 8.5%
Kosovo, 1.0%
Afghanistan, 52.3%
Iraq, 28.4%
Africa, 1.9%

Results

Evaluated for Clinical Competency Prior to Deployment



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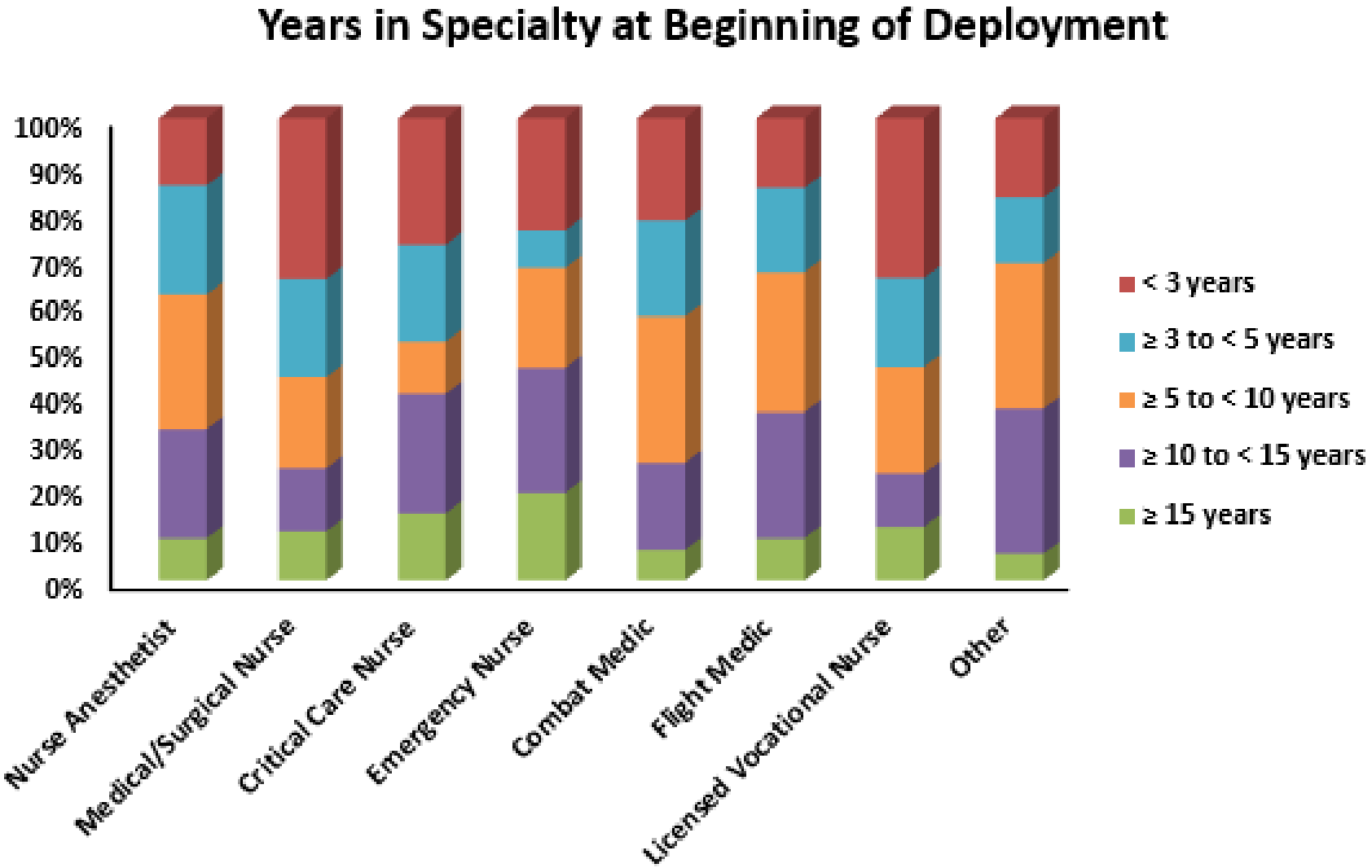
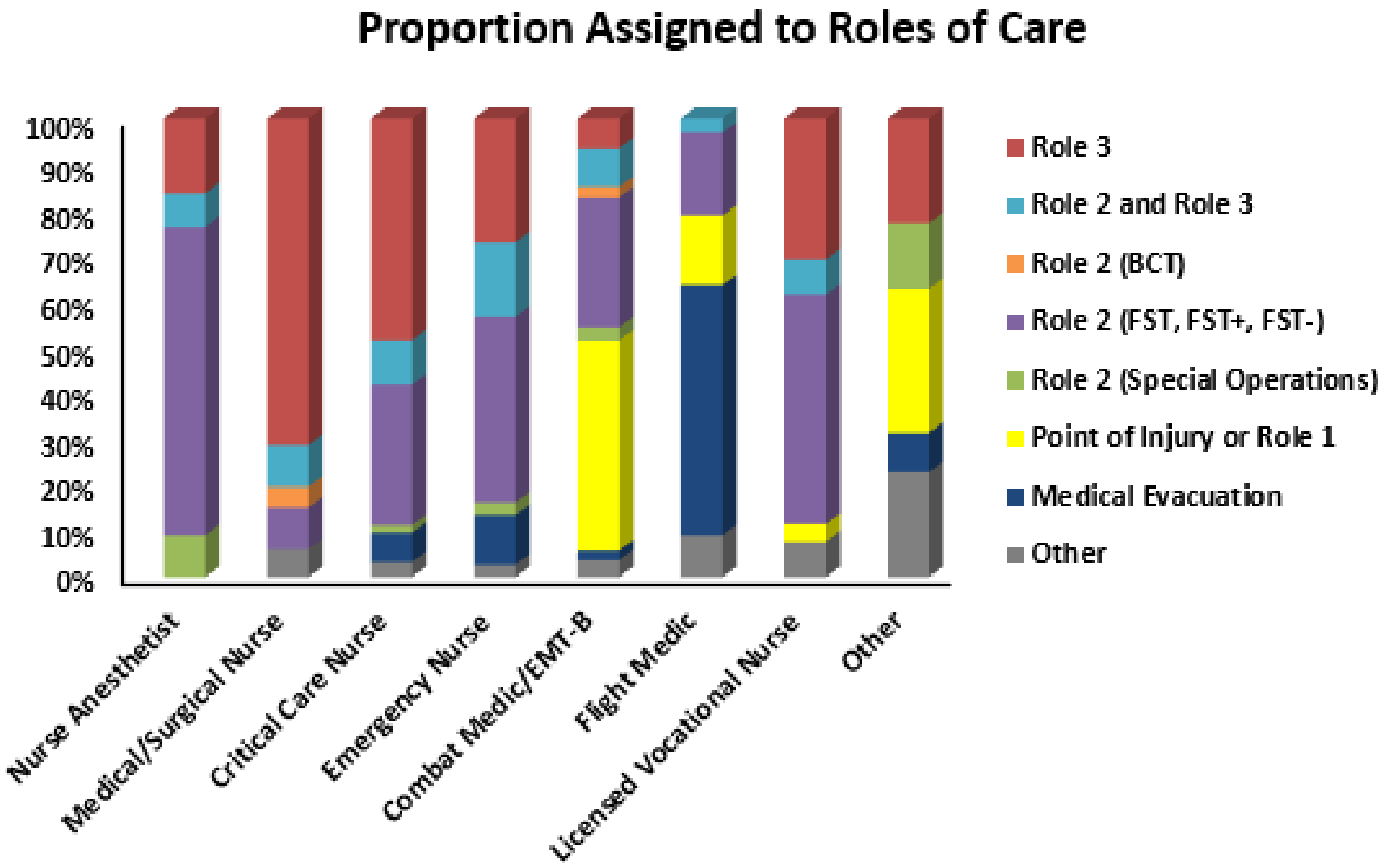
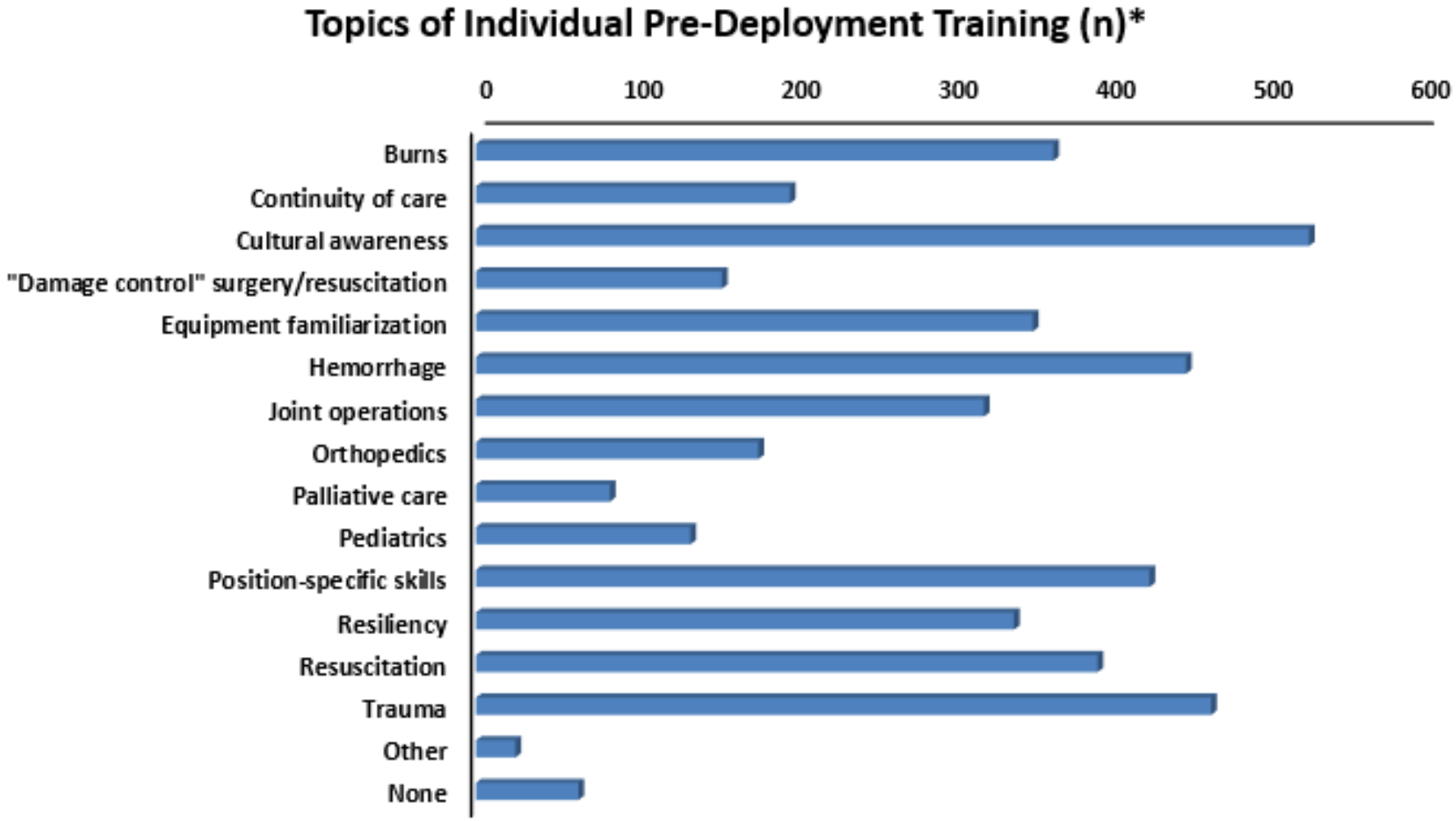

Years in Specialty at Beginning of Deployment
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic
Flight Medic
Licensed Vocational Nurse
Other
< 3 years
≥ 3 to < 5 years
≥ 5 to < 10 years
≥ 10 to < 15 years
≥ 15 years

Results


Proportion Assigned to Roles of Care
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Role 3
Role 2 and Role 3
Role 2 (BCT)
Role 2 (FST, FST+, FST-)
Role 2 (Special Operations)
Point of Injury or Role 1
Medical Evacuation
Other

Results



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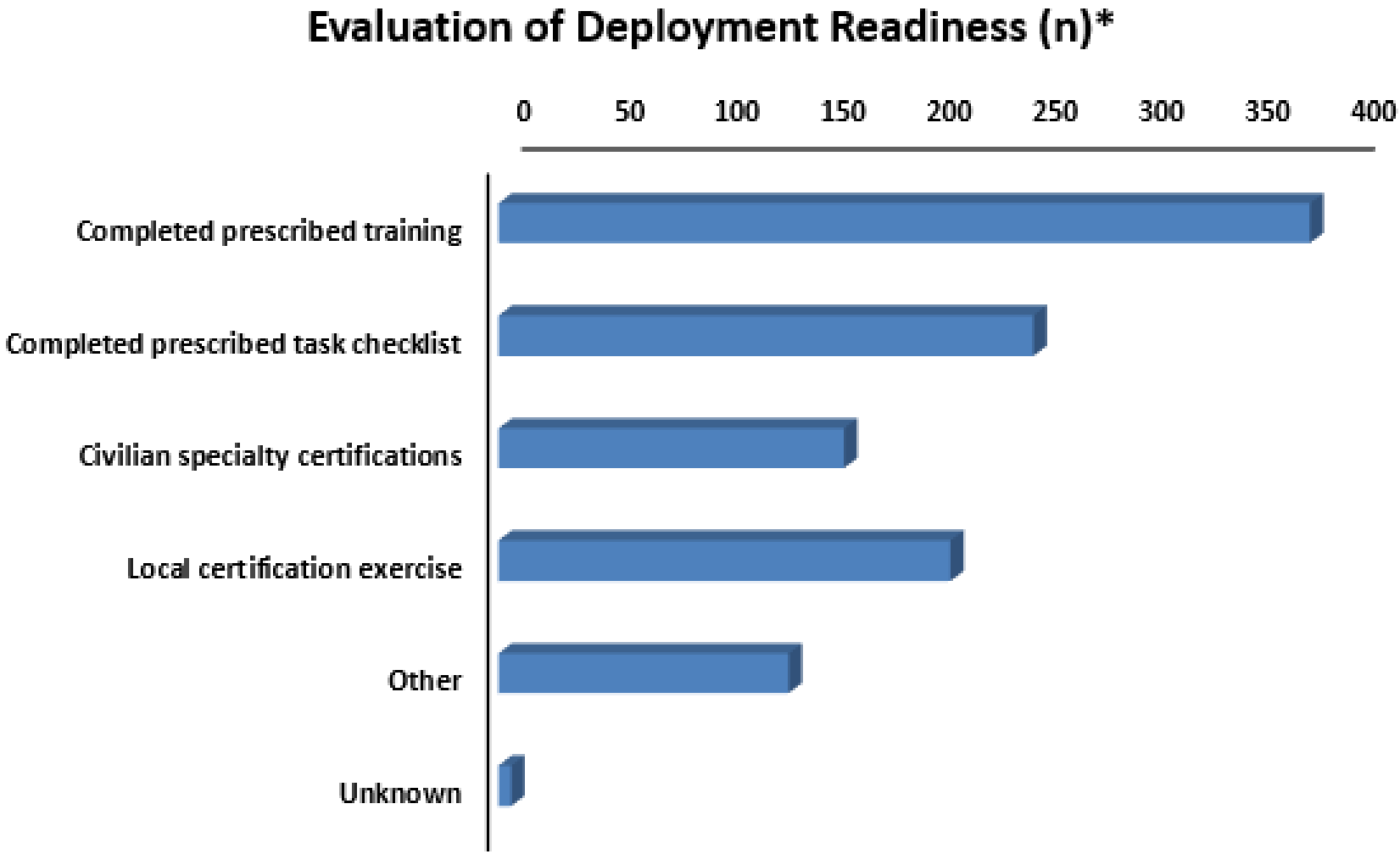

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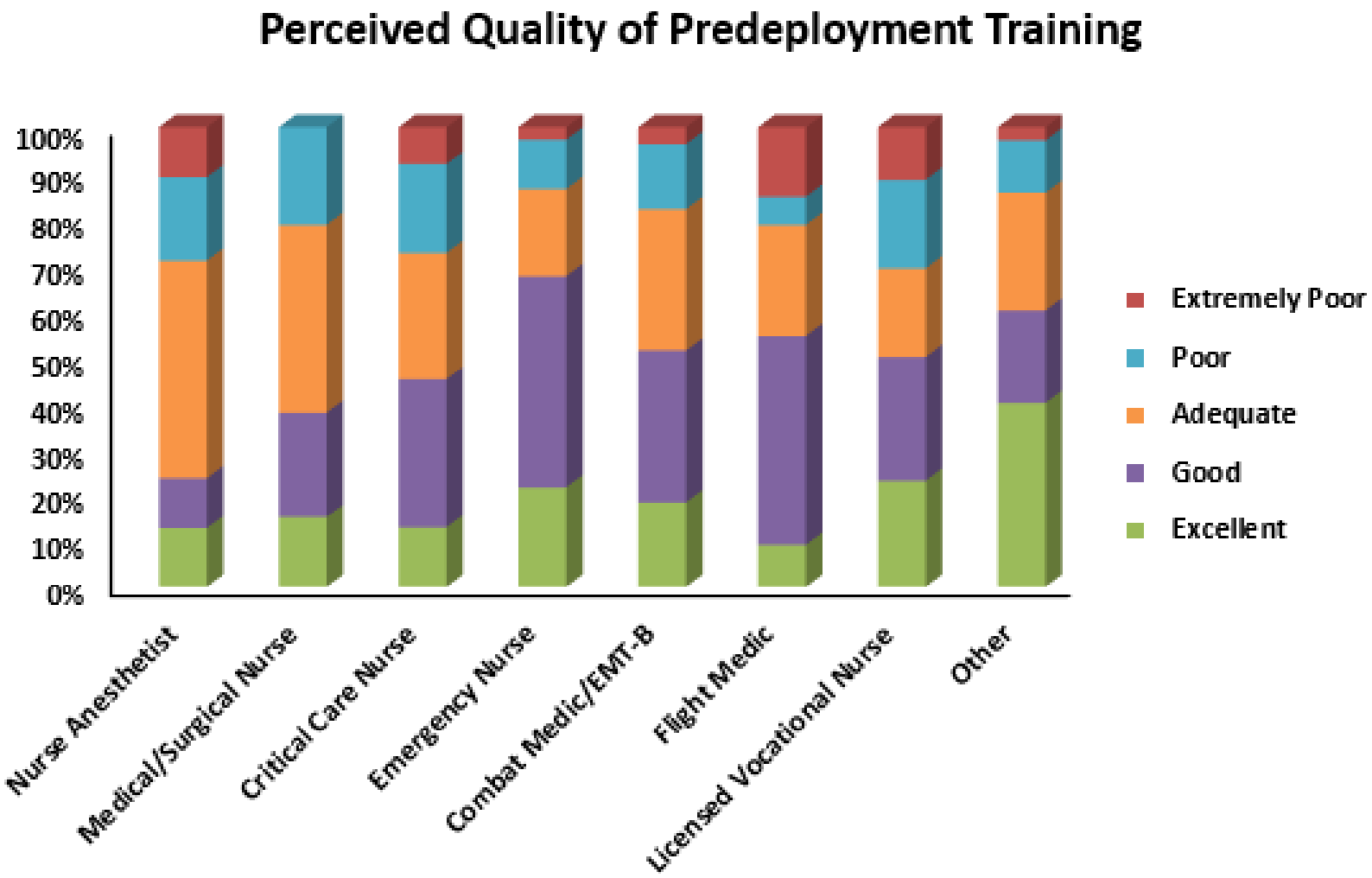
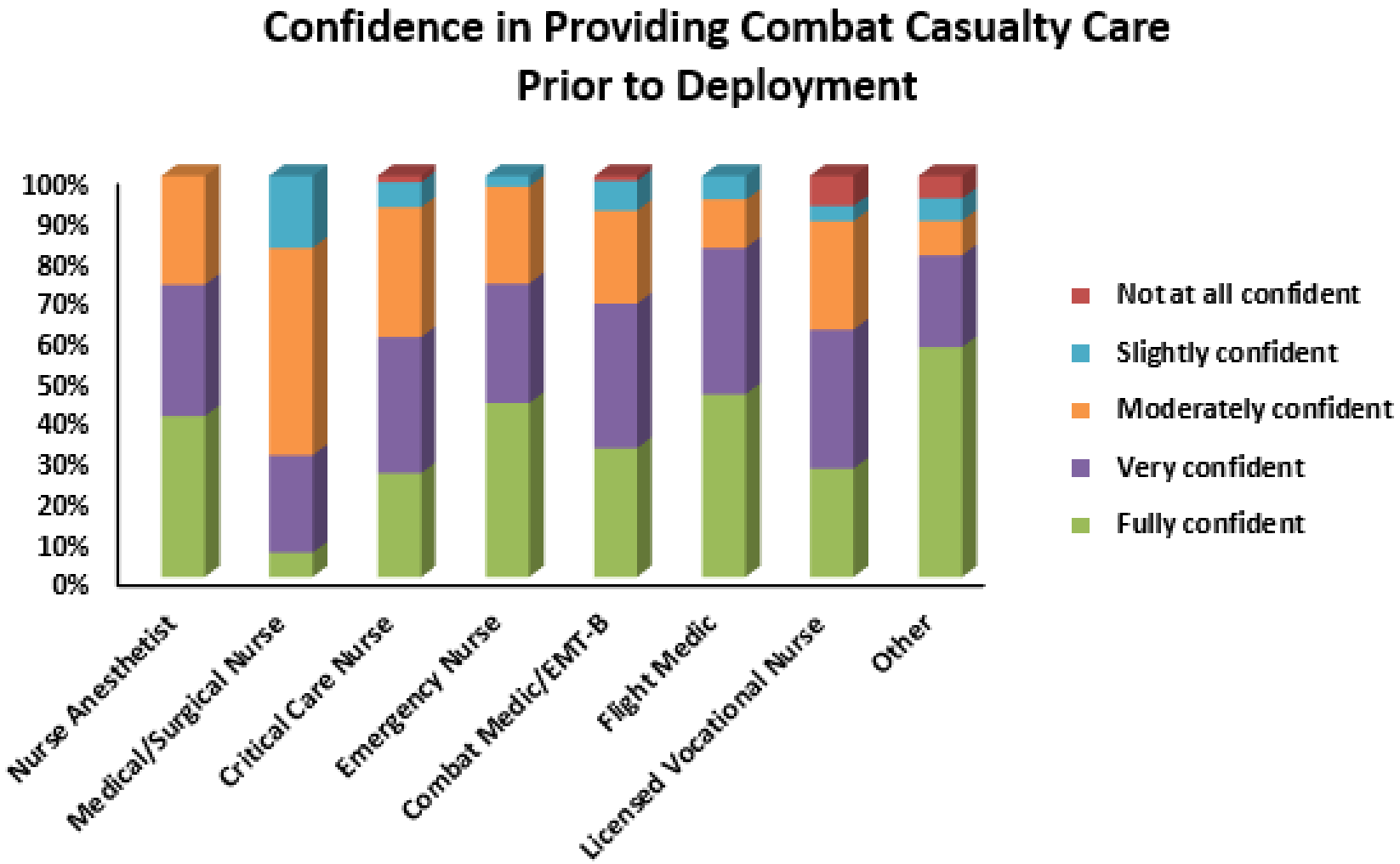
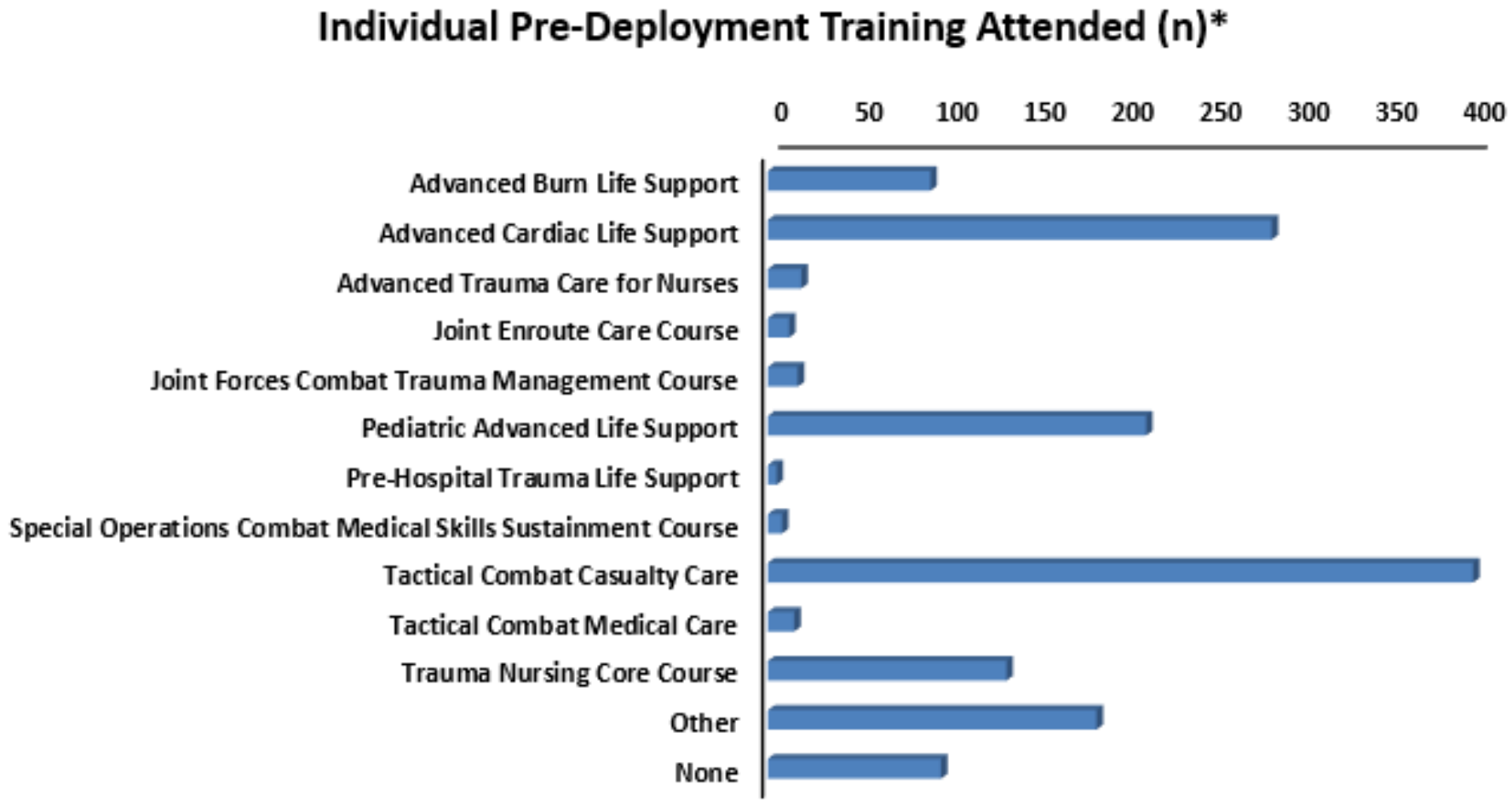

Perceived Quality of Predeployment Training
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Extremely Poor
Poor
Adequate
Good
Excellent

Results


Confidence in Providing Combat Casualty Care
Prior to Deployment
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Not at all confident
Slightly confident
Moderately confident
Very confident
Fully confident

Results



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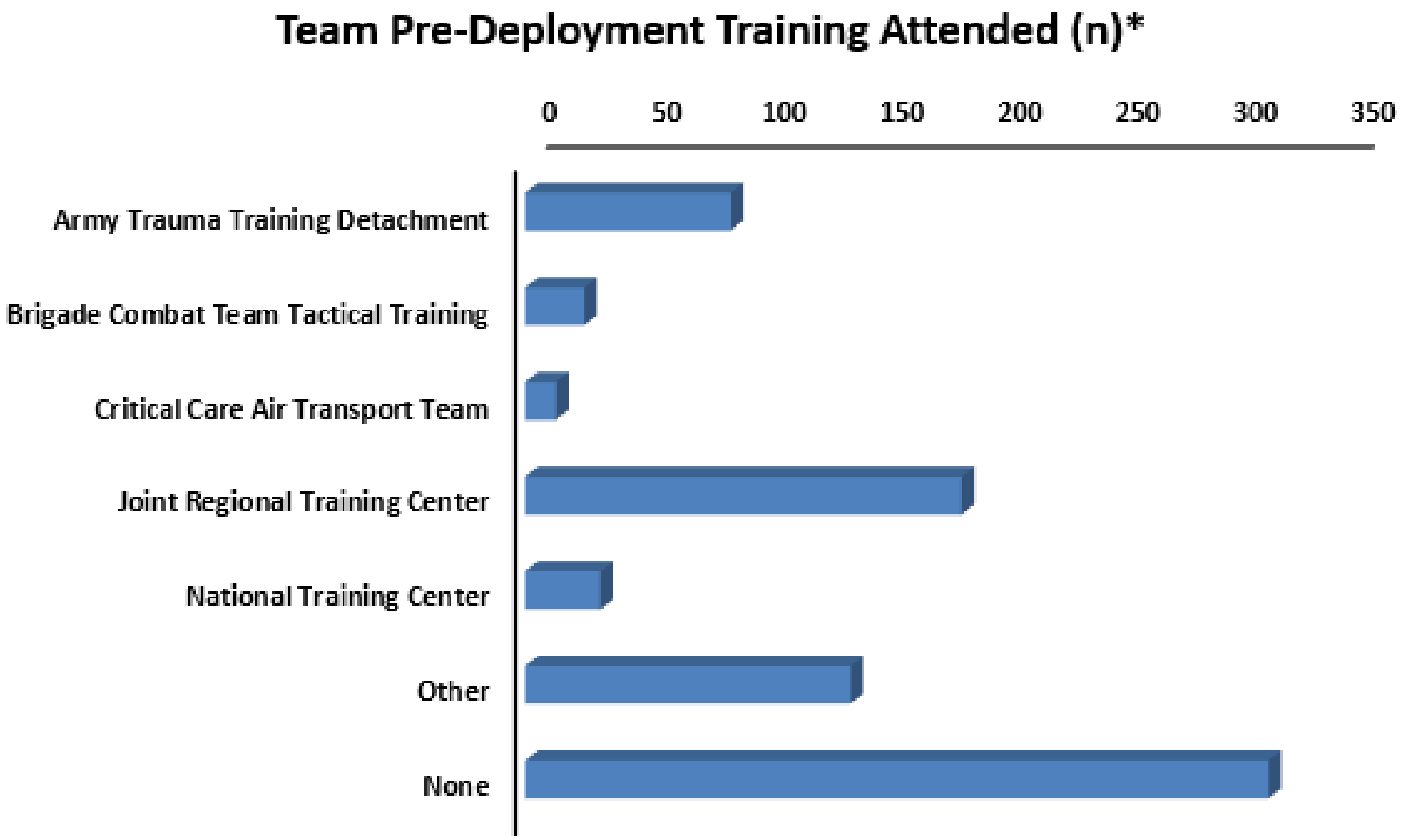
Results



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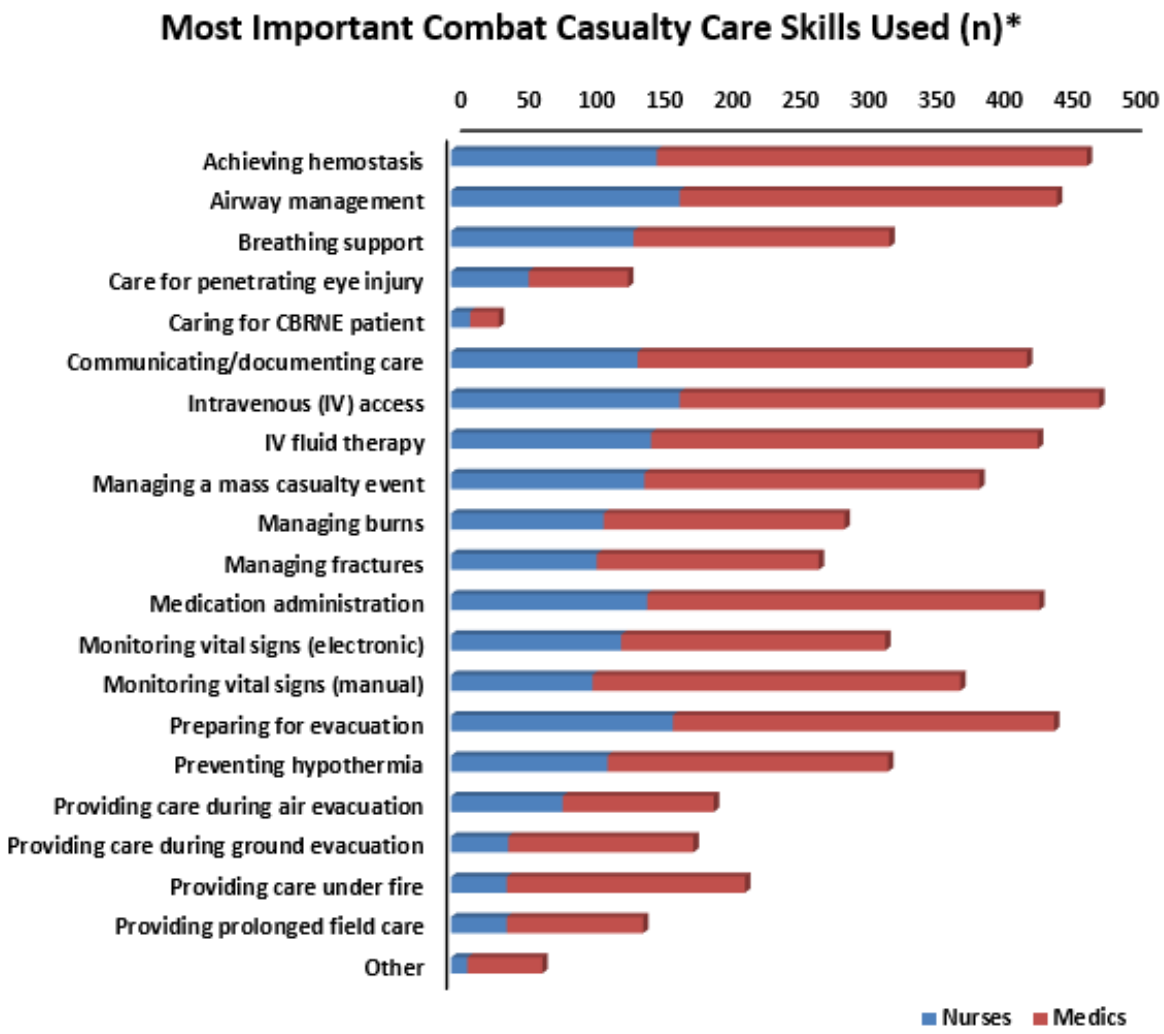
Results



* - Totals may be greater than 696 because participants could select more than one option

Results

* - Totals may be greater than 696 because participants could select more than one option

Discussion

- Most nurses and medics were satisfied with the quality of their pre-deployment training (when it occurred)
- Nurses and medics believed they were capable of providing effective combat casualty care
- Combat died of wounds rates started to rise recently, indicating that the trauma system may have previously unidentified limitations[4]
- Currently unable to link pre-deployment training to patient outcomes; success of training is subjective

Limitations

- Survey data only captured pre-deployment training for deployers and not for non-deployers
- Sample not representative of all nurse specialties

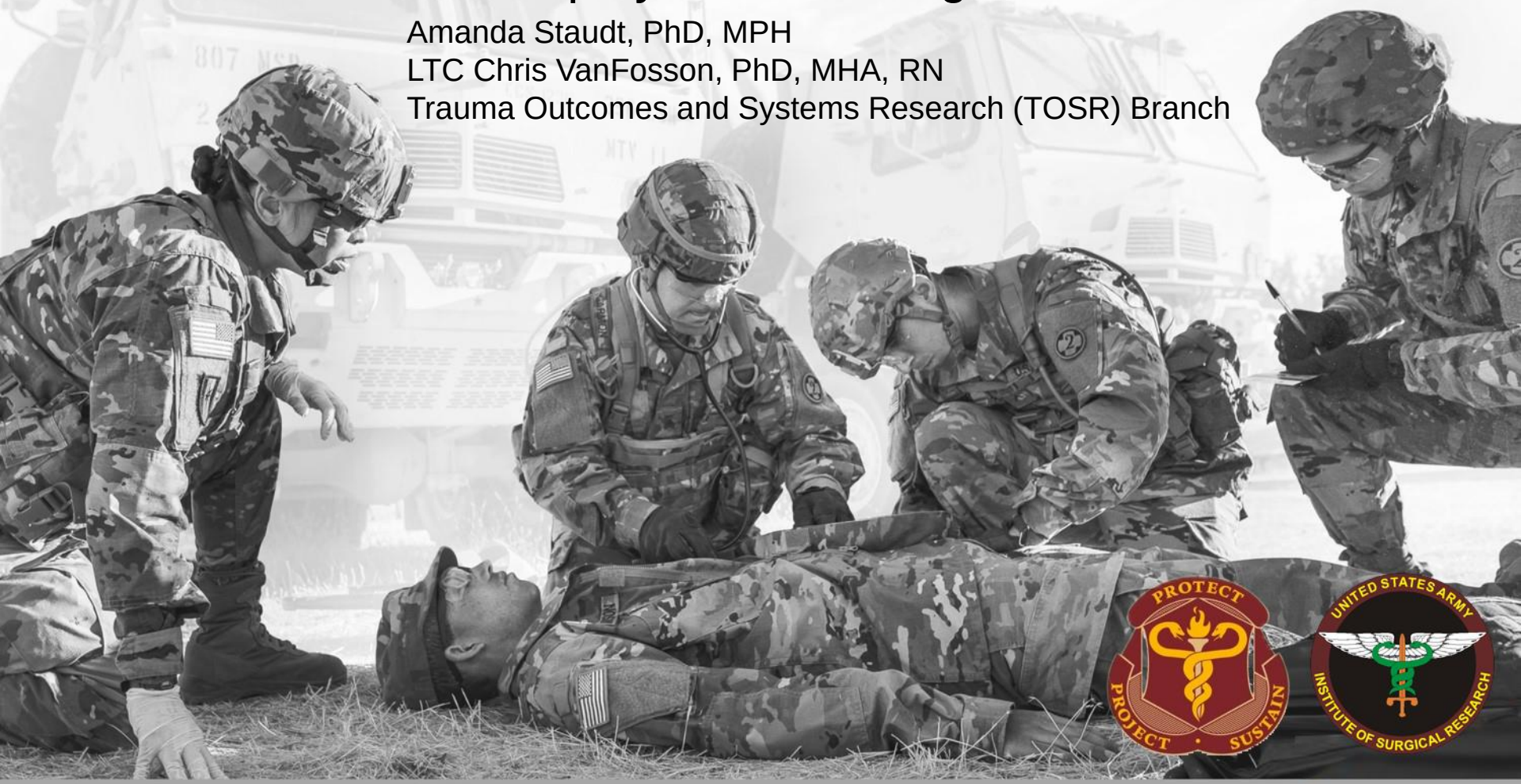
Conclusions

- Army nurses and medics felt confident and sufficiently prepared to provide trauma care during their deployments
- Increases in died of wounds rates may indicate that training was not sufficient
- To better understand the effectiveness of combat casualty care training, the Army must be able to link training events to objective measures, such as patient outcomes

Role 2 Grant Update:

Injury Patterns, Procedural Burden, & Pre-Deployment Training

Amanda Staudt, PhD, MPH
LTC Chris VanFosson, PhD, MHA, RN
Trauma Outcomes and Systems Research (TOSR) Branch



Disclaimer

The opinions or assertions contained herein are the private views of the author and not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

This study was conducted under a protocol reviewed and approved by the US Army Medical Research and Materiel Command Institutional Review Board and in accordance with the approved protocol.

Evaluation of Role 2 Resources

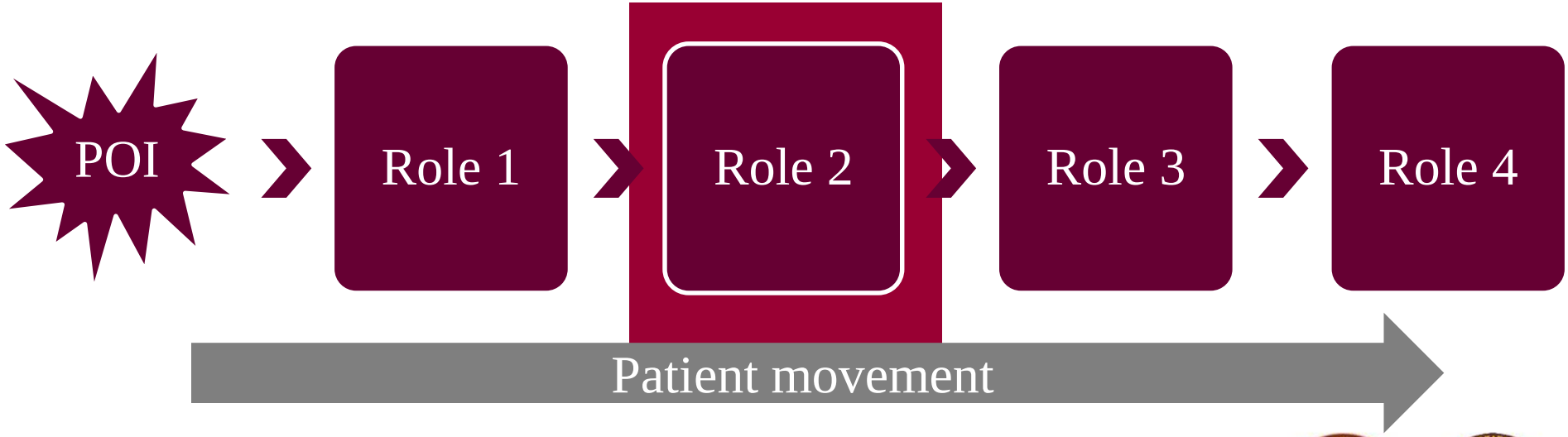
- Purpose: To describe and understand impact of Role 2 utilization during OEF and beyond, with emphasis on patient outcomes and provider competency

- Aims:
  - To describe all available OEF Role 2 information for combat casualties
  - To identify the ideal provider training and competency assessment, sustainment, and evaluation for medical staff deployed to Role 2 environment

Role 2

Role 2- far-forward surgical unit used for resuscitation and surgical stabilization of patients[1,5]



Army Forward Surgical Team

Resuscitative

- » 72 hour continuous operations
  - » 2 OR tables; 10 cases/day
  - » Post OP care 8 patients
- » 20-person team
  - » 3 general surgeons
  - » 1 orthopedic surgeons
  - » 2 Nurse anesthetists
  - » ~~1 OR nurse~~
  - » 2 ICU nurses
  - » 2 ER nurses
  - » Techs

+2 Emergency physicians

Split Role 2

- » 10 Providers
  - » 2 Surgeons
  - » 1 Nurse anesthetist
  - » 1 ICU nurse
  - » 1 ER nurse
  - » 5 Techs
- » Capabilities
  - » Damage control surgery
  - » Damage control resuscitation
  - ~~» Patient hold~~
  - ~~» Life support~~

Outline

- Injury Pattern & Procedural Burden
- Pre-Deployment Training
- Pre-proposal ideas
  - Whole blood
  - Pressure Ulcers

- Supplemental: Continuum of care overview

Role 2 Injury pattern and procedure burden analysis

Background

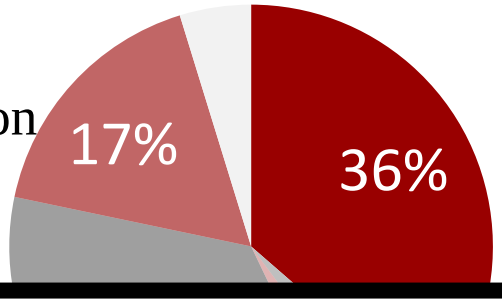
- 20,000 U.S. battle-injured casualties + >60,000 other casualties
- Until recently, no consistent data collection before Role 3 from DoDTR
- Data collection requires leadership support
- Other barriers to data collection at far-forward facilities include:
  - Harsh/austere conditions
  - Hazardous terrain
  - Weather extremes
  - Limited resources

Role 2 Database

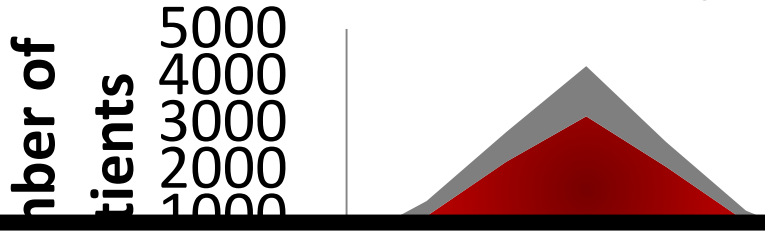
- Started 2008
- Data from **surgical** teams
- Role 2 clinical providers voluntarily collect
- Convenience sampling

Mann-Salinas study

Patient Affiliation

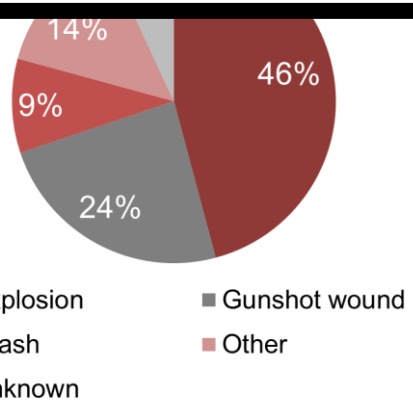


Battle versus Non-Battle Injuries

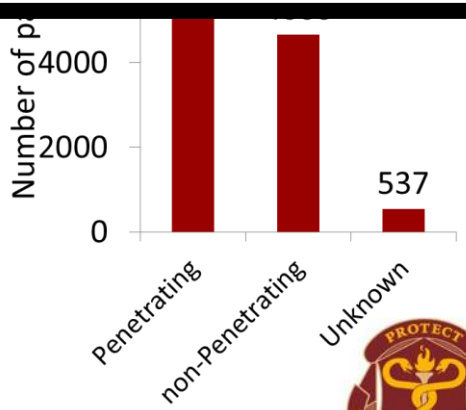


Evaluation of role 2 (R2) medical resources in the Afghanistan combat theater: Initial review of the joint trauma system R2 registry

Elizabeth A. Mann-Salinas, PhD, RN, Tuan D. Le, MD, DrPH, Stacy A. Shackelford, MD, Jeffrey A. Bailey, MD, Zsolt T. Stockinger, MD, Mary Ann Spott, PhD, Michael D. Wirt, MD, PhD, Rory Rickard, PhD, FRCS, Ian B. Lane, BDS, MPH, Timothy Hodgetts, PhD, FRCP, Sylvain Cardin, PhD, Kyle N. Remick, MD, *and* Kirby R. Gross, MD, *San Antonio, Texas*



Injury type



Turner study

Combat surgical workload in Operation Iraqi Freedom and Operation Enduring Freedom: The definitive analysis

Caryn A. Turner, MPH, Zsolt T. Stockinger, MD,
and **Jennifer M. Gurney, MD, FACS**, *Fort Sam Houston, Texas*

			Total
			1,605 (13.01)
Amputation, n (%)	1,278 (5.43)	7,325 (4.42)	8,603 (4.55)
Cardiac, n (%)	84 (0.36)	342 (0.21)	426 (0.23)
Neurosurgical, n (%)	143 (0.61)	5,484 (3.31)	5,627 (2.97)
Endoscopy, n (%)	205 (0.87)	3,795 (2.29)	4,000 (2.11)
External fixation, n (%)	1,608 (6.83)	6,367 (3.84)	7,975 (4.22)
Fasciotomy, n (%)	1,100 (4.67)	3,760 (2.27)	4,860 (2.57)
Genitourinary, n (%)	163 (0.69)	2,020 (1.22)	2,183 (1.15)
Head and neck, n (%)	643 (2.73)	7,640 (4.61)	8,283 (4.38)
Hand, n (%)	156 (0.66)	1,665 (1.01)	1,821 (0.96)
Ophthalmologic, n (%)	92 (0.39)	4,635 (2.8)	4,727 (2.5)
Orthopedic, n (%)	3,289 (13.97)	22,894 (13.82)	26,183 (13.84)
Peripheral nervous system, n (%)	112 (0.48)	884 (0.53)	996 (0.53)
Spine, n (%)	0	638 (0.39)	638 (0.34)
Soft tissue, n (%)	7,570 (32.15)	63,377 (38.27)	70,947 (37.5)
Thoracic, n (%)	268 (1.14)	1,489 (0.9)	1,757 (0.93)
Tracheostomy/Cricothyroidotomy, n (%)	297 (1.26)	2,891 (1.75)	3,188 (1.69)
Vascular, n (%)	2,375 (10.09)	9,973 (6.02)	12,348 (6.53)
Grand Total, n (%)	23,548 (12.45)	165,619 (87.55)	189,167 (100)
Country			
Afghanistan, n (%)	15,778 (67)	78,822 (47.5)	94,600 (50.01)
Iraq, n (%)	7.767 (32.9)	86,796 (52.4)	94,563 (49.9)
Not available, n (%)	3 (0.01)	1 (0)	4 (0)
Grand Total, n (%)	23,548 (12.45)	165,619 (87.55)	189,167 (100)

Objective

- Among battle and non-battle injured casualties treated at Role 2 facilities in Afghanistan:
  - Describe the injuries
  - Calculate procedural burden received by casualties
  - Identify those at an increased risk for loss of life, limb, or eyesight

Weight procedures by frequency, mortality, and morbidity

Data sources

- Secondary data analysis
- Retrospective study
- Role 2 Database
  - AIS _ _ _ _ _ _ _ . _
  - FCI
  - ICD-9-CM
- Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software categorization scheme

Study population, n=10,992

- Adult
- Surgical Role 2 patients
- Battle or non-battle injured
- Afghanistan
- February 2008 to September 2014
- Documented injury (x=12,450)
- Received an intervention (x=27,251)

Outcome measures

- Mortality
- Non-fatal unanticipated findings
  - Hypothermia
  - Anemia/Blood loss
  - Hypovolemia
  - Shock
  - Cardiopulmonary resuscitation
  - Progression of original neurologic insult
  - Compartment syndrome extremity
  - Hemothorax
  - Respiratory failure
  - Organ/nerve/vessel perforation or injury
  - Among other measures

Variables

- Demographics
- Blood products/fluids
- Injuries
  - Body region
  - Anatomic structure
  - Specific anatomic structure (whole area injuries)
  - Severity
- Procedures
  - Non-operating
  - Operating

Life, limb, or eyesight identification

- Used multiple metrics to identity patients at risk of losing their life, limb, or eyesight

- Risk of loss of life
  - Procedure burden rank (percent mortality)
  - AIS=6
  - Deceased
  - FCI=1

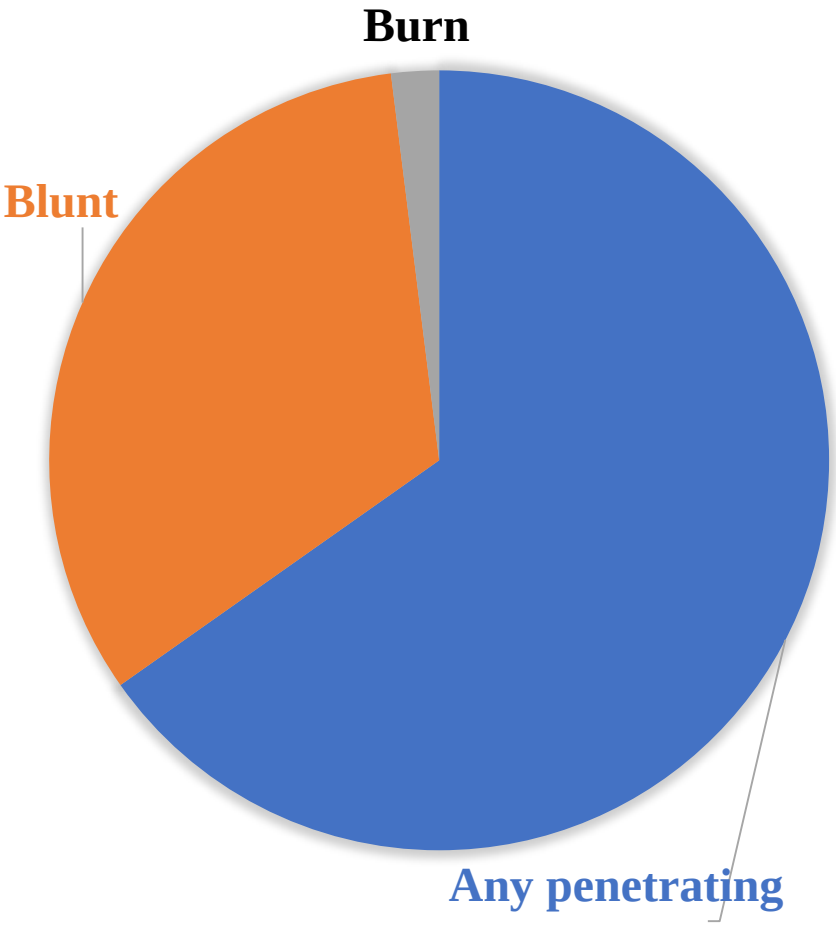
- Risk of loss of limb
  - Procedure burden rank (procedure group)
  - FCI
  - AIS extremity body regions
    - Anatomic structure
    - Severity

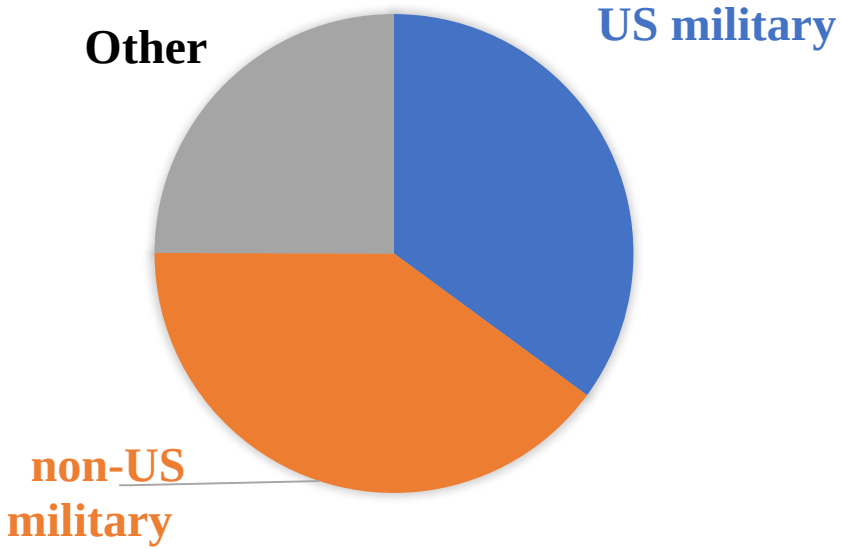
- Risk of loss of eyesight
  - Procedure burden rank (procedure group)
  - FCI
  - SME judge potential injury caused blindness

Statistical analysis

- Descriptive analysis
- Operative procedures
  - Counts < 5 not presented
  - Cumulative burden of procedures
    - Frequency
    - Mortality
    - Morbidity

Demographics



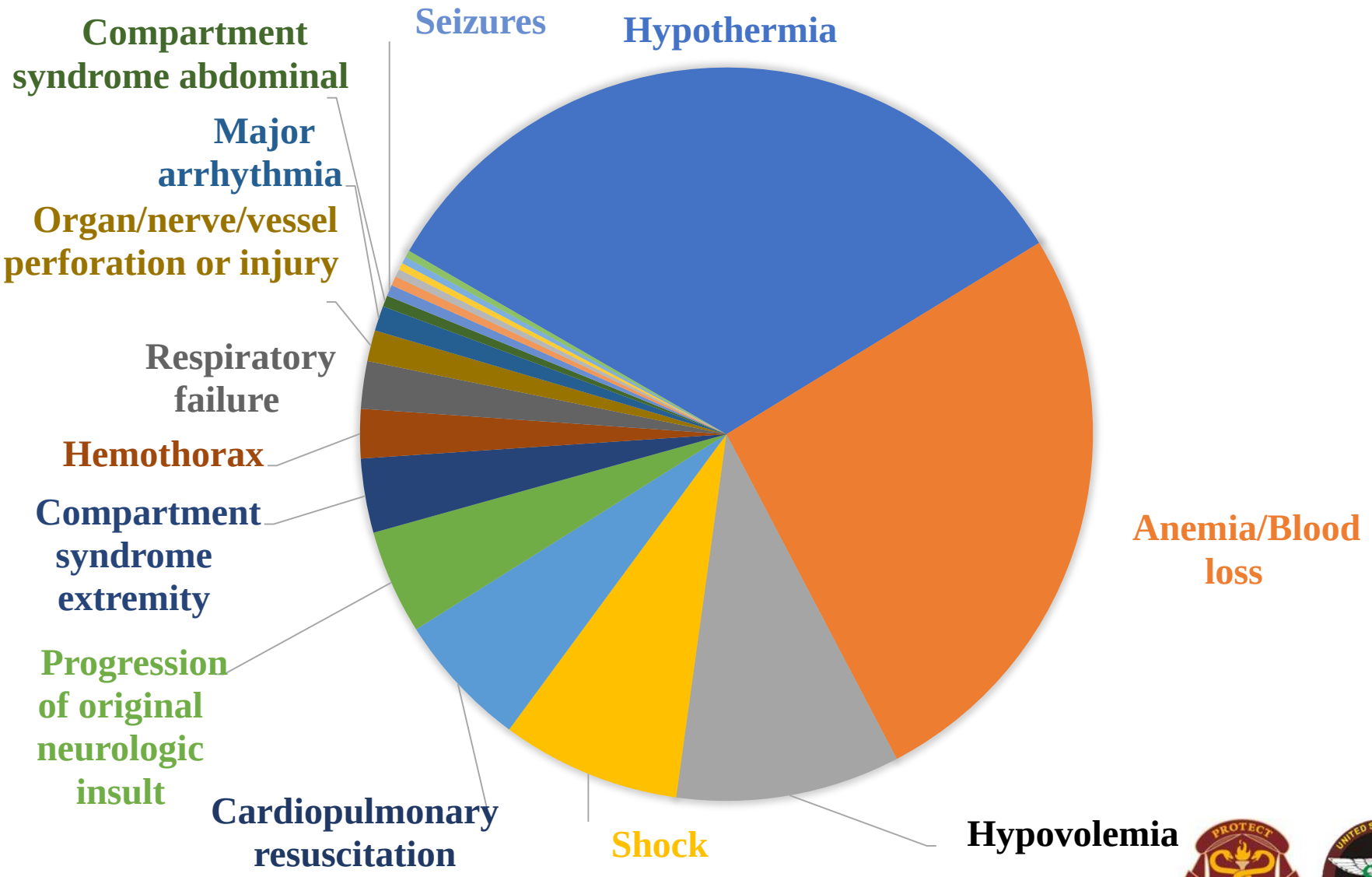


- 97.8% male
- Median (IQR) age= 25 (22-30)
- Median (IQR) ISS=2 (1, 5)
- Mortality= 4.4%

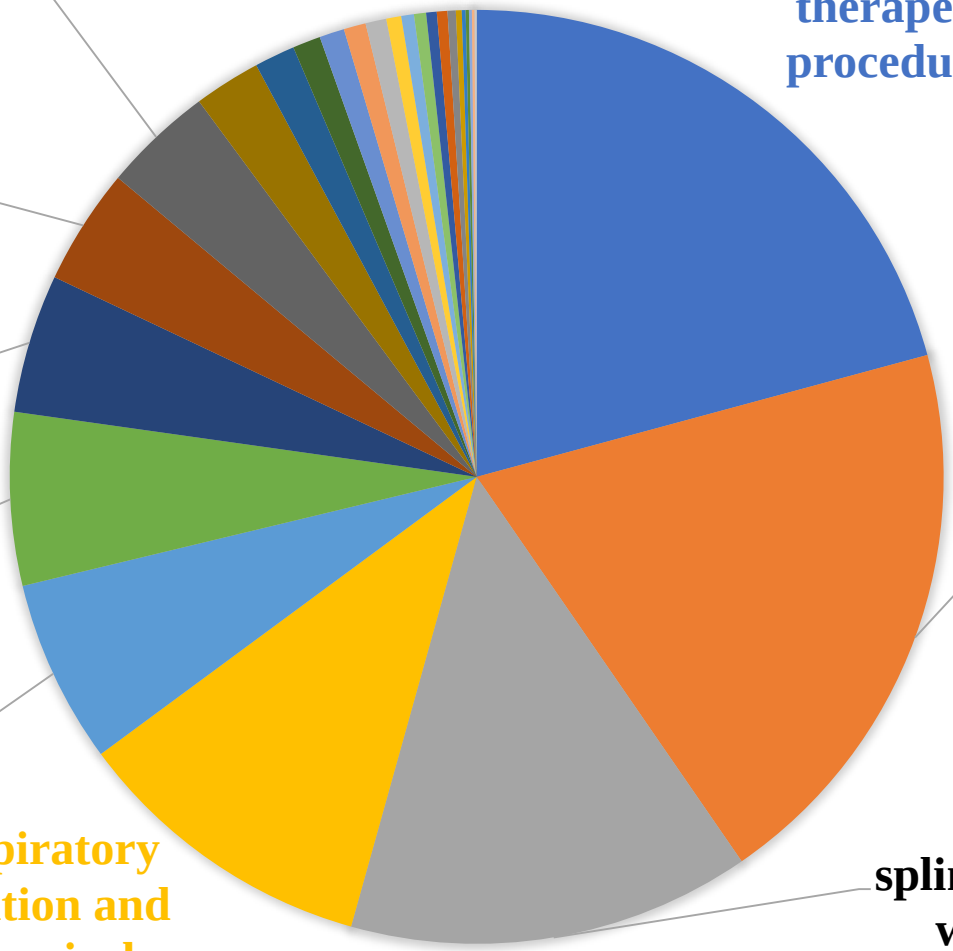
Blood product

In-Hospital 1st 24 hour	n	Median (IQR)
Fluid, L		
Crystalloids	9,187	1.1 (1.0, 2.1)
Colloids	531	0.5 (0.5, 1.0)
Blood product, units		
Whole blood	366	4.0 (2.0, 7.0)
packed Red Blood Cells	1,971	4.0 (2.0, 8.0)
Platelets	249	2.0 (1.0, 3.0)
Cryoprecipitate	262	3.0 (2.0, 7.0)
Fresh frozen plasma	1,617	4.0 (2.0, 7.0)

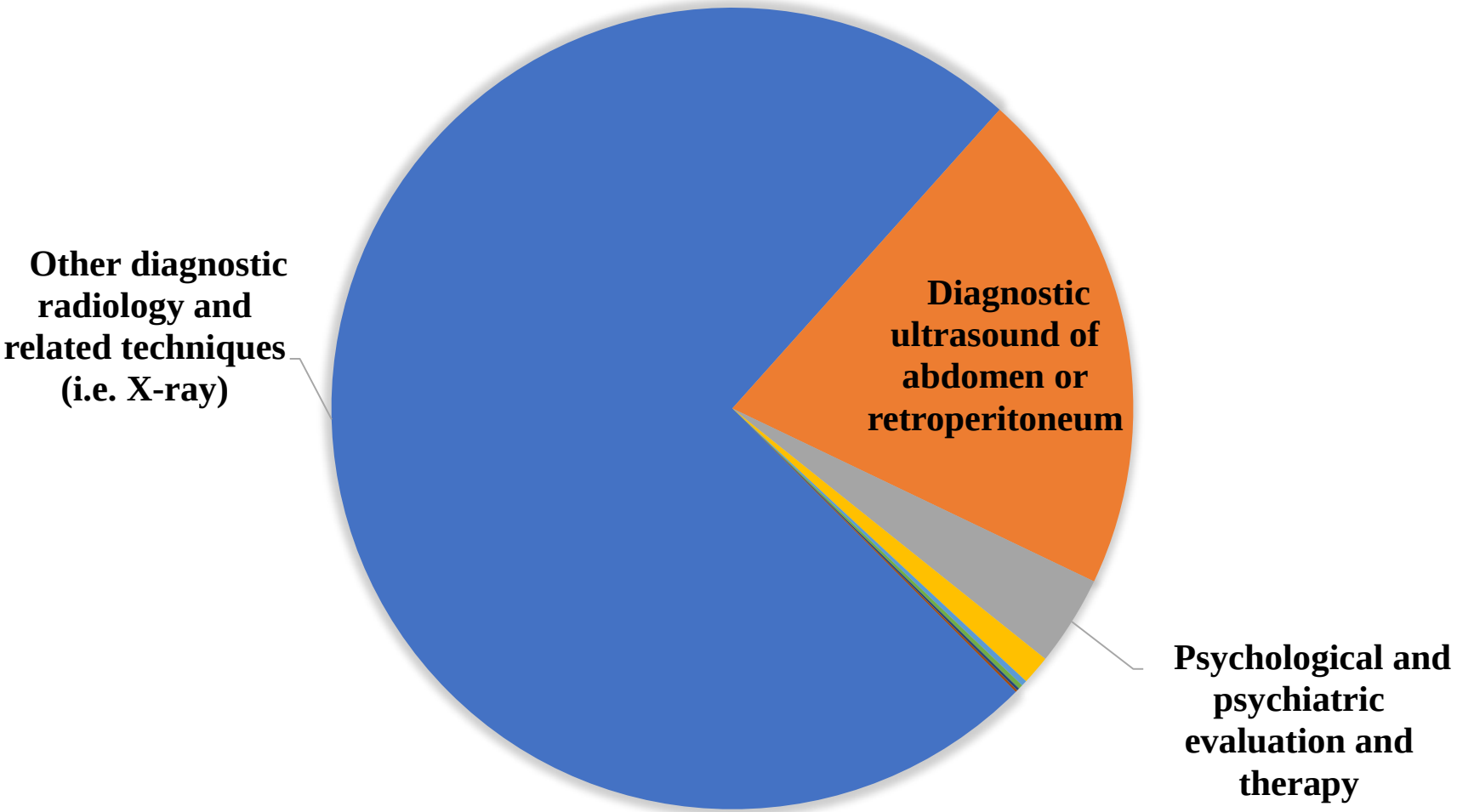
Non-fatal unanticipated outcomes



Non-operative therapeutic procedures



Non-operative diagnostic procedures

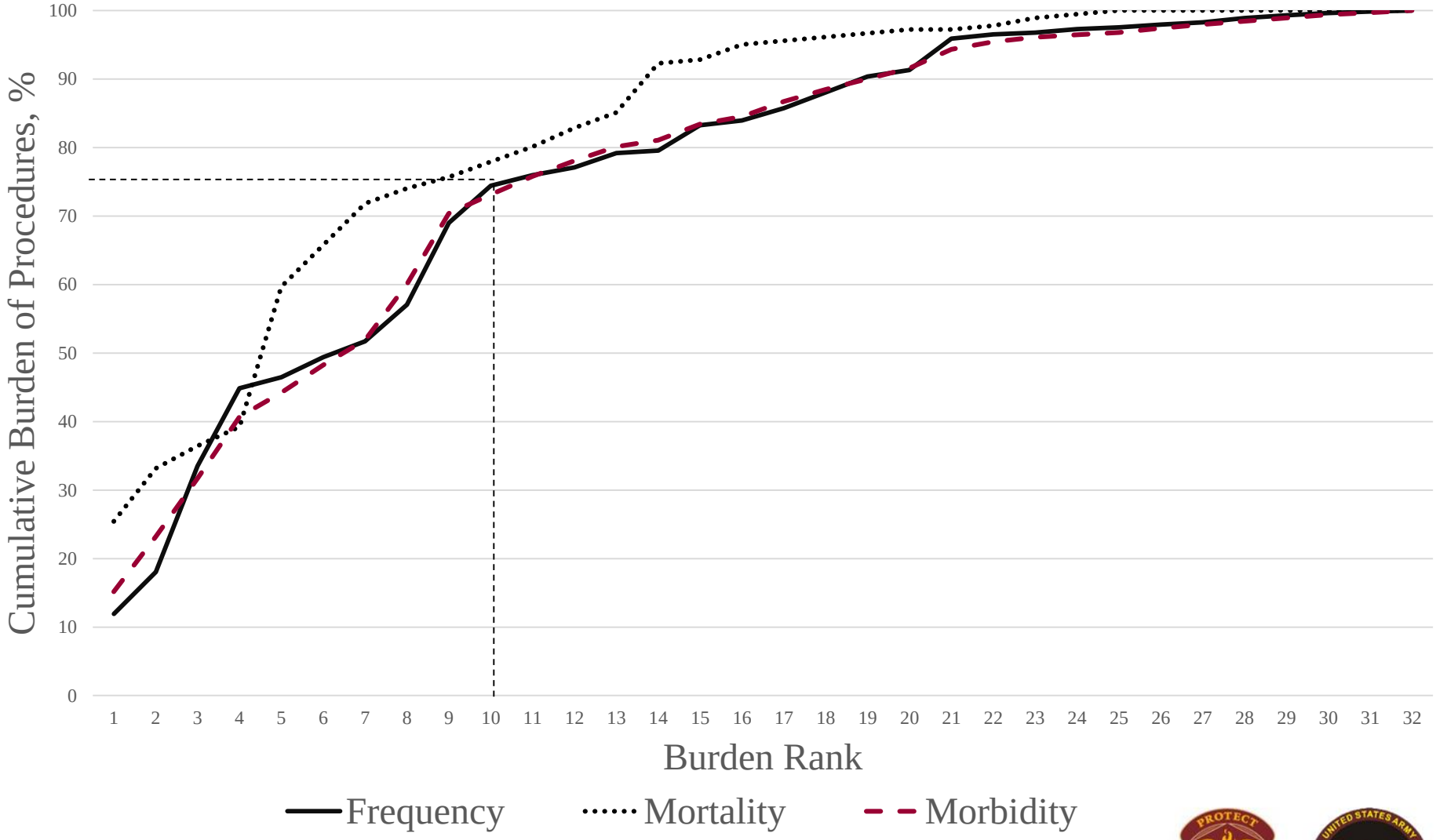


Burden calculation

Table 3. All operating room procedures groups by burden rank

Burden Rank	Procedure Group	Procedure Count[a], 2008-2014	Percent Mortality	Percent Morbidity	Rank Mortality	Rank Morbidity	Combined Burden Score
1	Exploratory laparotomy	444	10.4	43.5	1	1	2
2	Vascular procedures other than head and neck	228	6.1	44.7	3	6	9
3	Debridement	577	1.0	18.9	7	4	11
4	External fixator	423	1.2	27.0	8	3	11
5	Thoracotomy	60	61.7	75.0	2	9	11
6	Resection, Repair, Suture, or incision of large or small intestine, duodenum, or colon	110	10.0	46.4	5	7	12
7	Suture of liver, abdominal wall, pancreas, or omentum; Laparotomy NEC; Pancreatectomy; Groin I	86	12.8	54.7	5	8	13
8	Amputation of lower extremity	199	2.0	52.3	10	5	15
9	Therapeutic procedures on muscles and tendons	445	0.7	29.4	15	2	17
10	Debridement of open fracture, internal fixation, or reduction to lower extremity (other than hip (	202	2.0	17.3	10	10	20
11	Resection of large intestine	58	6.9	58.6	10	12	22
12	Splenectomy	42	11.9	69.0	8	14	22
13	Debridement of open fracture, internal fixation, or reduction to hip and femur	78	5.1	33.3	10	16	26
14	Cardiopulmonary resusitation, pericardial window	13	100.0	92.3	4	22	26
15	Debridement of open fracture, internal fixation, or reduction to radius and ulna	139	0.7	21.6	17	13	30
16	Skull and brain procedures	25	16.0	56.0	10	20	30
17	Amputation, Disarticulation of upper extremity or unspecified	68	1.5	41.2	17	15	32
18	Arthrotomy	86	1.2	25.6	17	17	34
19	Exploration, neck	85	1.2	23.5	17	18	35
20	Suture of diaphragm or lung, Trachea repair	36	2.8	55.6	17	18	35
21	Debridement of open fracture, internal fixation, or reduction to humerus, hand or unspecified	171	0.0	20.5	25	11	36
22	Nephrectomy	23	4.3	60.9	17	20	37
23	Lung Lobectomy, Lung resection	10	20.0	80.0	16	23	39
24	Exam of Eye Under Anesthesia	19	5.3	26.3	17	29	46
25	Canthotomy, Canthoplasty	9	11.1	44.4	17	30	47
26	Arterial bypass	15	0.0	53.3	25	23	48
27	Stomach suture	12	0.0	58.3	25	25	50
28	Debridement of open facial fracture	24	0.0	25.0	25	26	51
29	Orchiectomy, Penis Suture, Scrotum repair	15	0.0	40.0	25	26	51

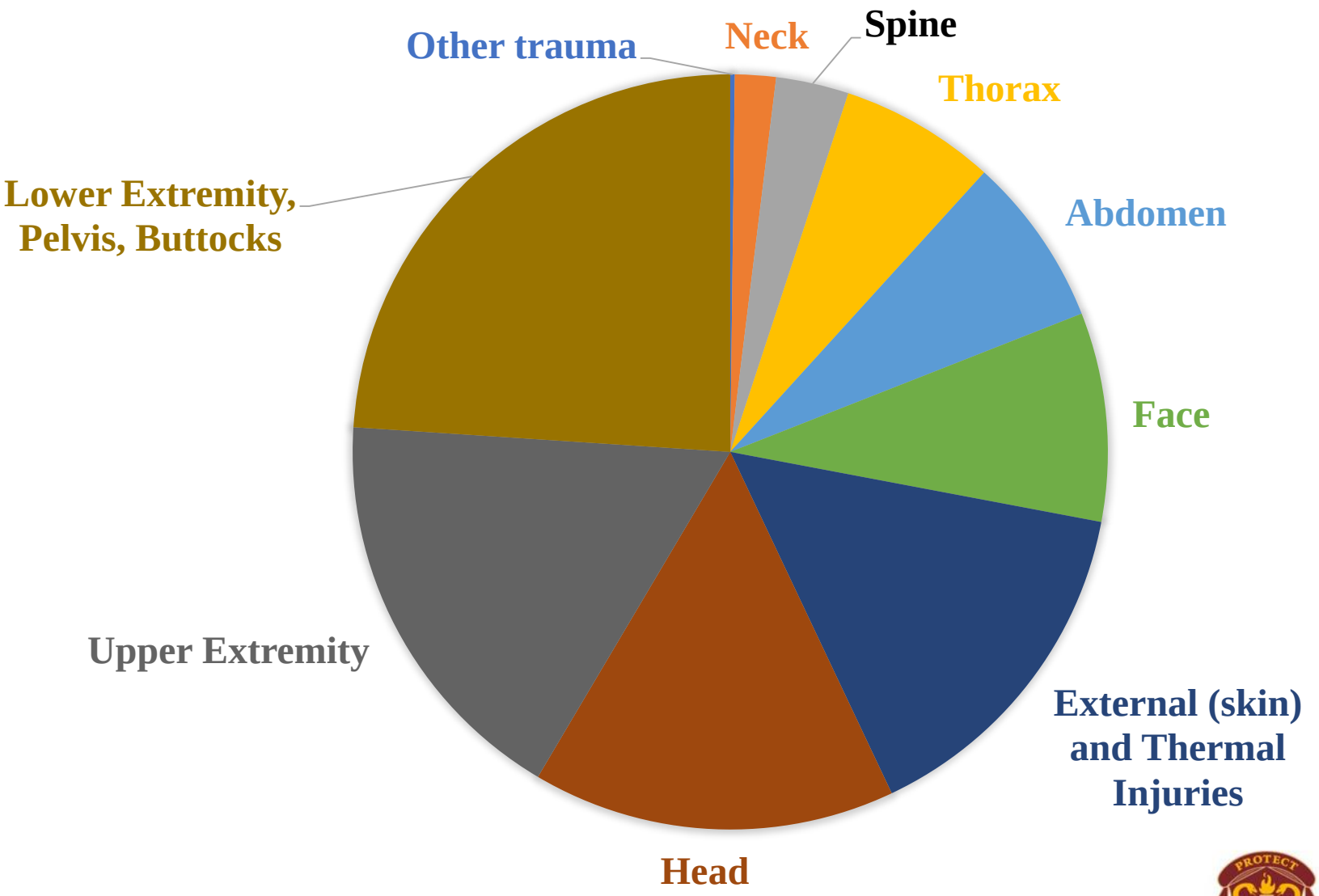
Cumulative Burden of Procedures by Burden Rank



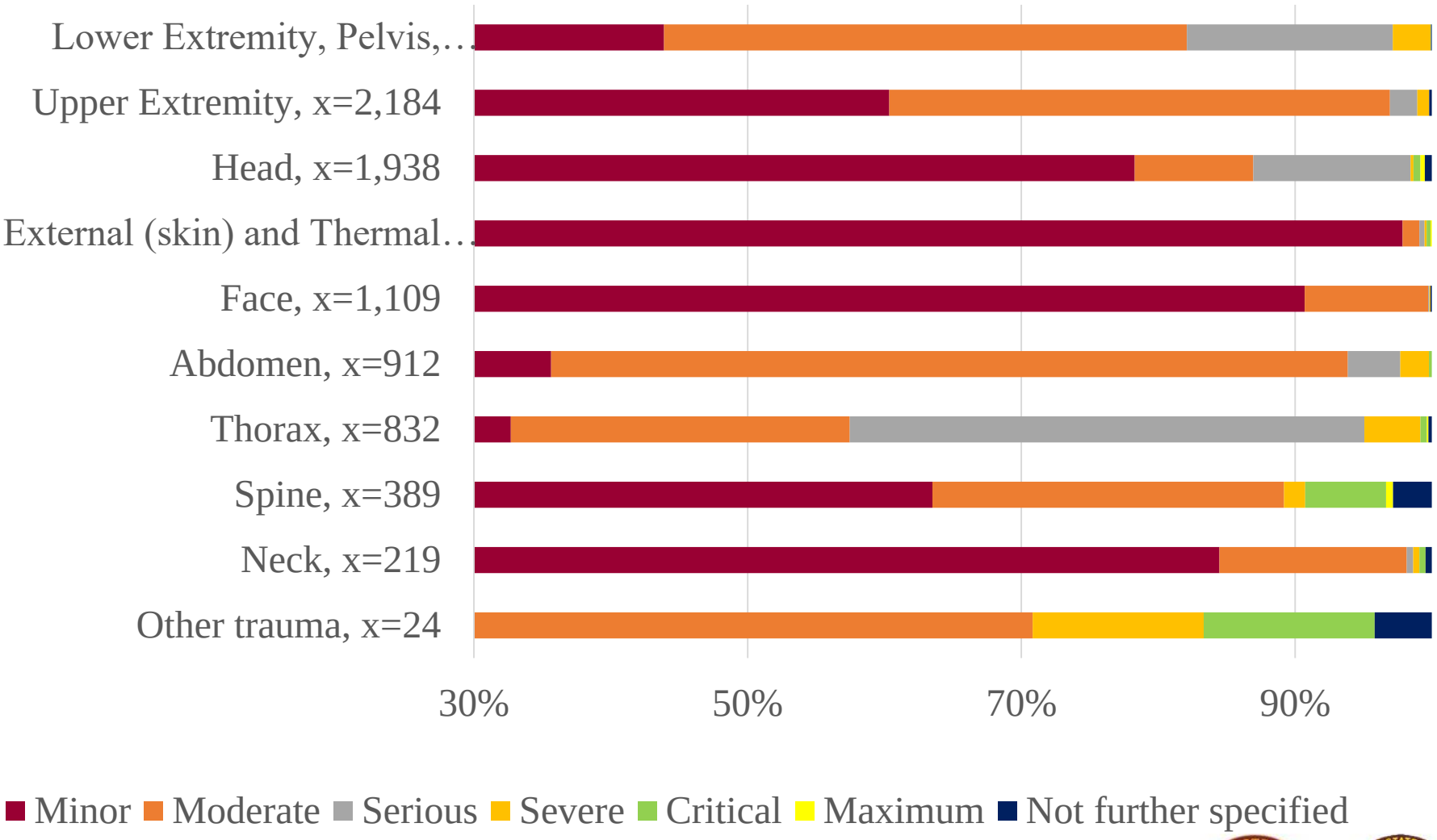
Top 10 Most Important Operative Procedures

1. Exploratory laparotomy
2. Vascular procedures other than head and neck
3. Debridement
4. External fixator
5. Thoracotomy
6. Resection, Repair, Suture, or incision of large or small intestine, duodenum, or colon
7. Suture of liver, abdominal wall, pancreas, or omentum; Laparotomy NEC; Pancreatectomy; Groin Exploration
8. Amputation of lower extremity
9. Therapeutic procedures on muscles and tendons
10. Debridement of open fracture, internal fixation, or reduction to lower extremity (other than hip or femur)

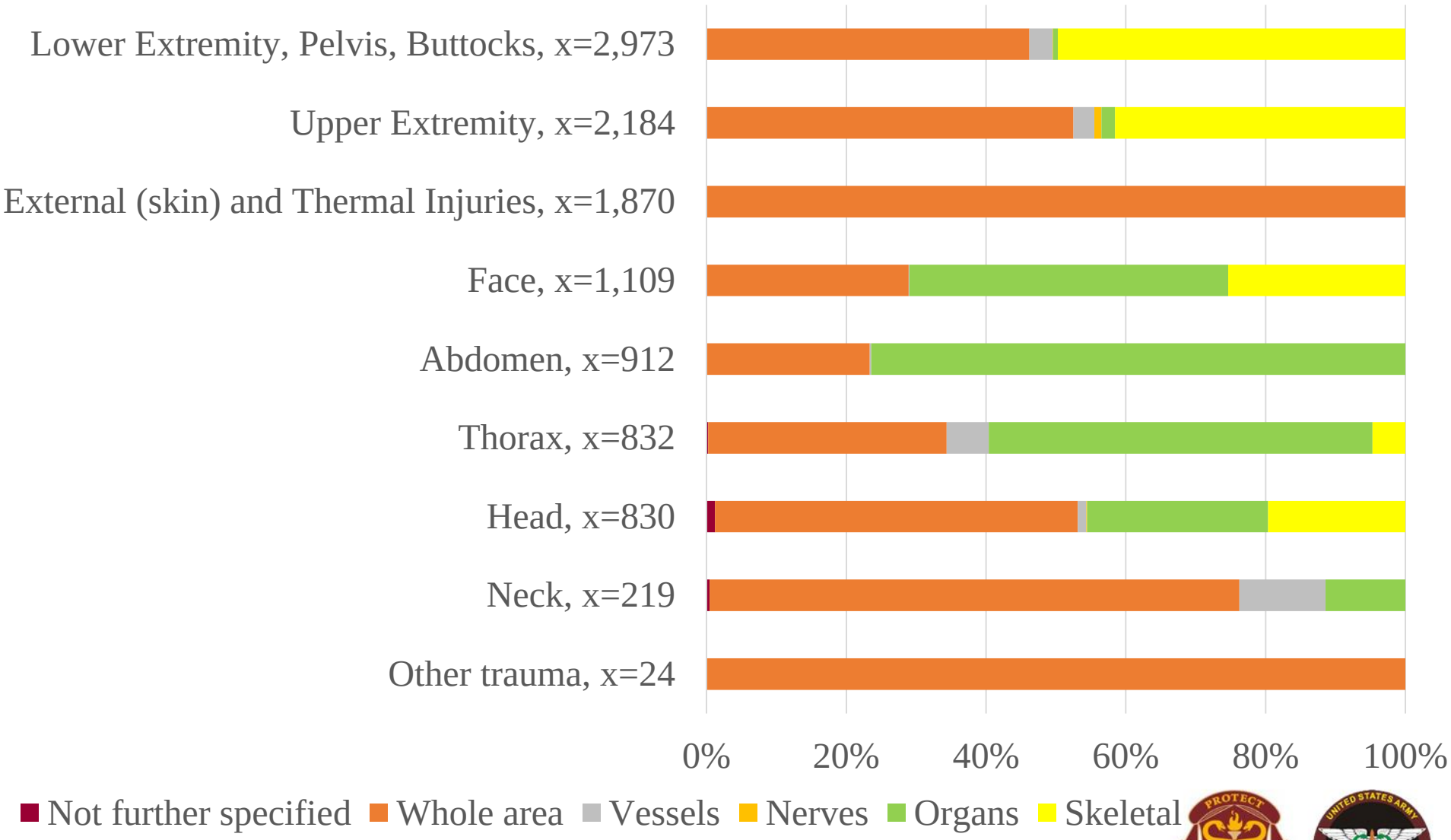
Injured body region



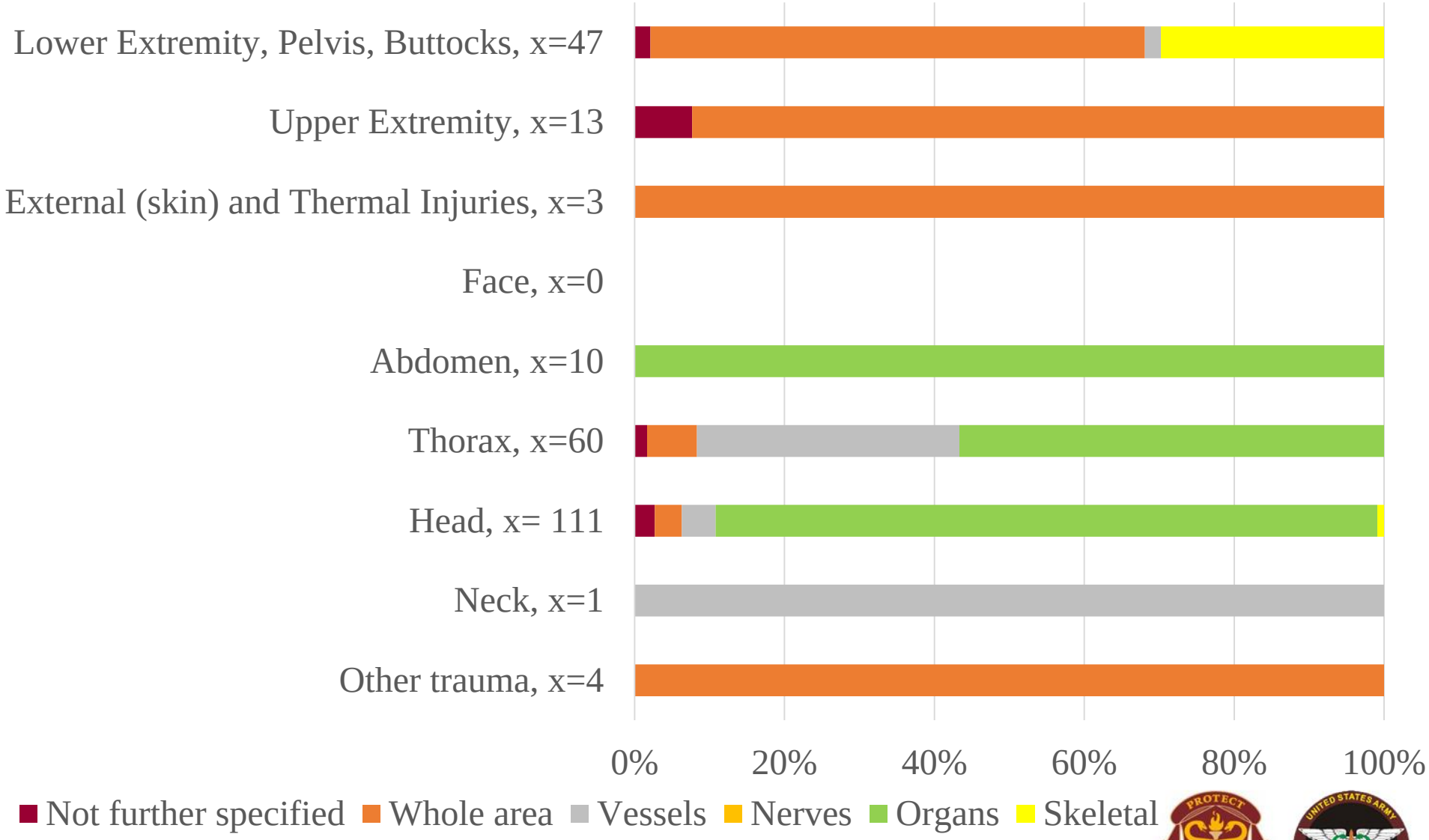
Body region by severity (x=12,450)



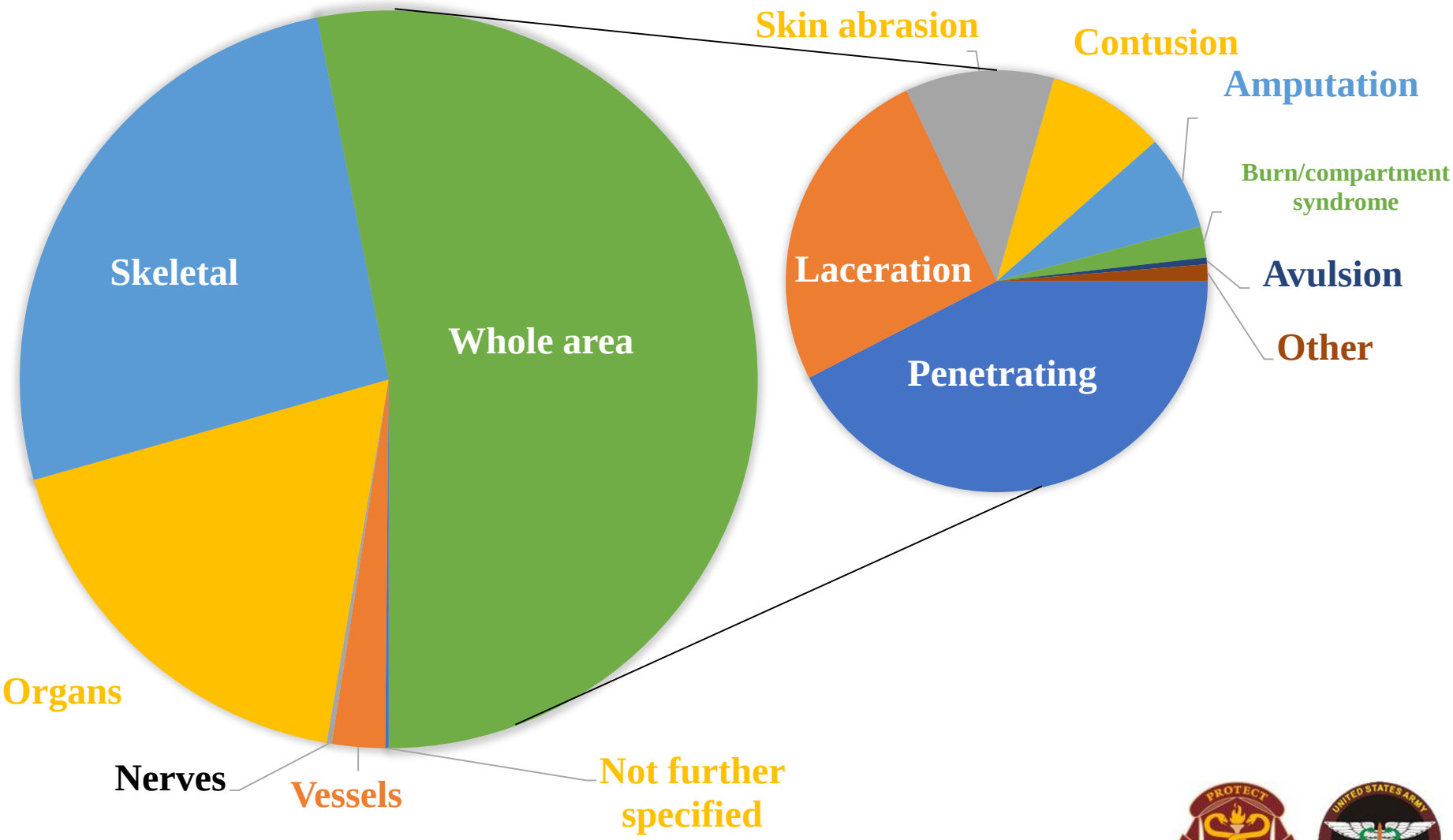
Body region by anatomic structure (x=10,953)



Injuries with AIS>2 among deceased (n=249)



Anatomical structure

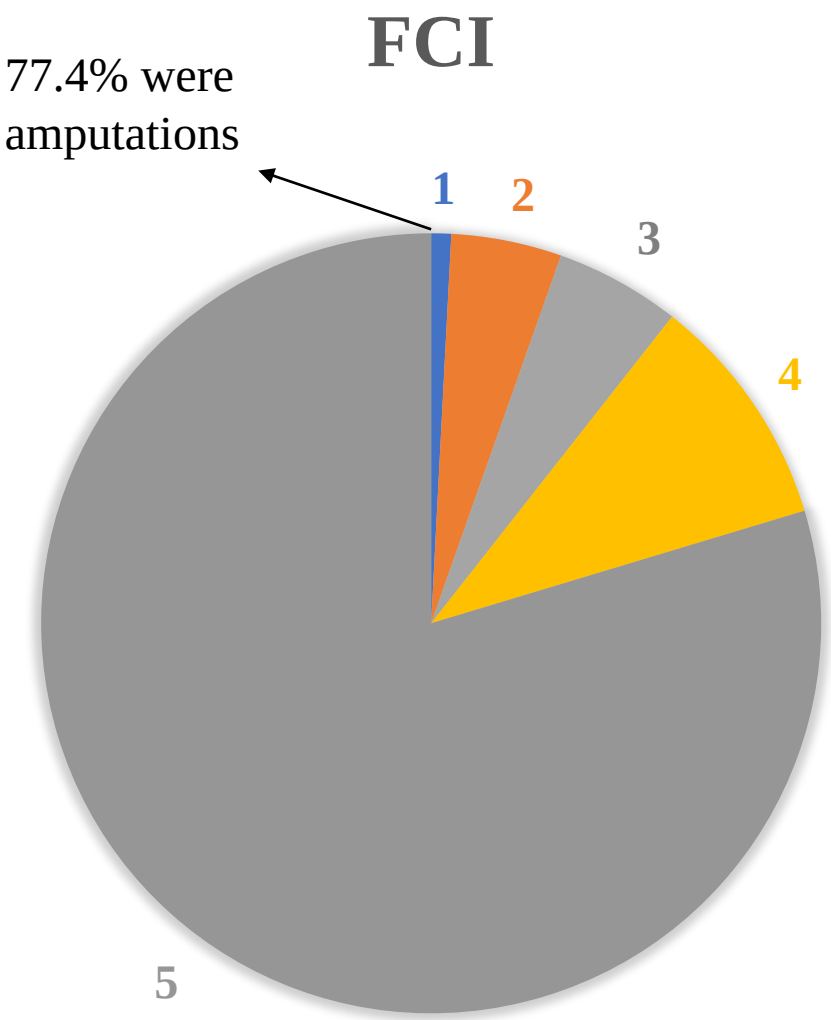


Poly-trauma patients (n=89)

Primary body region	Secondary body region: Other	Head	Face	Neck	Thorax	Ab	Spine	UE	LE	Skin & Thermal
Other		0	0	0	1	0	1	0	1	0
Head			0	0	6[a]	2[a]	2	6[b]	10	1
Face				0	2	0	0	0	0	0
Neck					0	0	0	0	0	0
Thorax						12[a,c]	10	4[d]	9	1[a]
Ab							2	1	2	0
Spine								0	0	0
UE									15	0
LE										1
Skin and Thermal										

[a] includes 1 injury to the Lower Extremity, Pelvis and Buttocks as a tertiary body region
[b] includes 3 injuries to the Lower Extremity, Pelvis and Buttocks as a tertiary body region
[c] includes 1 injury to the Spine as a tertiary body region
[d] includes 2 injuries to the Lower Extremity, Pelvis and Buttocks as tertiary body regions

Life-threatening injuries



- AIS=6 for 11 patients
- Diagnoses
  - massive burns
  - myocardium avulsions
  - multiple organ injury with loss of one or more limbs and/or decapitation
  - spinal injuries
- 6/11 survived Role 2 discharge

- Procedures with >15% mortality
  - #14 Cardiopulmonary resusitation, pericardial window
  - #5 Thoracotomy
  - #23 Lung Lobectomy, Lung resection
  - #16 Skull and brain procedures

Procedure burden for limb-threatening injuries

- #4 External fixator
- #8 Amputation of lower extremity
- #9 Therapeutic procedures on muscles and tendons
- #10 Debridement of open fracture, internal fixation, or reduction to lower extremity (other than hip or femur)
- #13 Debridement of open fracture, internal fixation, or reduction to hip and femur
- #15 Debridement of open fracture, internal fixation, or reduction to radius and ulna
- #17 Amputation, Disarticulation of upper extremity or unspecified
- #21 Debridement of open fracture, internal fixation, or reduction to humerus, hand or unspecified

Eye-threatening injuries

- Procedure burden
  - #24 Exam of Eye Under Anesthesia
  - #25 Canthotomy, Canthoplasty
- 369 eye injuries
  - 30 likely blind
  - 5 potentially blind
- Diagnoses
  - eye avulsion/enucleation
  - retinal detachments
  - cornea lacerations
  - sclera laceration/rupture or injury
  - choroid rupture
  - eye injuries with retained intraocular foreign body

Summary

- Many minor injuries, some poly-trauma injuries
- Risk of losing their life, limb, or eyesight
- ~20% predicted to suffer long-term morbidity
- Most common non-operative procedures:
  - x-ray
  - ultrasound
  - wound care
  - catheterization
  - intubation
- 10 procedure groups are attributable to ~75% of all operations, deaths, and unexpected outcomes
- 80% received crystalloids (median=1.1 L)
- 19% received transfusion
- Top 4 non-fatal unanticipated findings
  - hypothermia
  - anemia/blood loss
  - hypovolemia
  - shock

Limitations

- Data collected by healthcare professionals:
  - Voluntary data collection
  - Limited data entry staff
- Role 2 Database is not validated against medical records

Largest source of Role 2 data available

Policy Implications

- Research and pre-deployment training programs should focus on these injuries and common and complex procedures
- Resource medical assets at Role 2 facilities using this information
- Continue data collection at these facilities to support future efforts

Pre-deployment training analysis

Objective

To survey trauma care-oriented Army nurses (RNs and LVNs) and combat medics to describe the range of pre-deployment trainings they experienced in order to provide guidance on future pre-deployment training requirements

Methods

- Survey method
  - Approved by IRB (exempt) and ARL
  - Intelink.gov survey platform
  - Questions based on READI tool[3]
- Link sent to military email accounts
  - Army nurses from active (n=2,344) and reserve (n=2,458) components
  - Active duty combat medics (n=17,535)
- 3 monthly reminders
- Targeted up to 2 most recent deployments

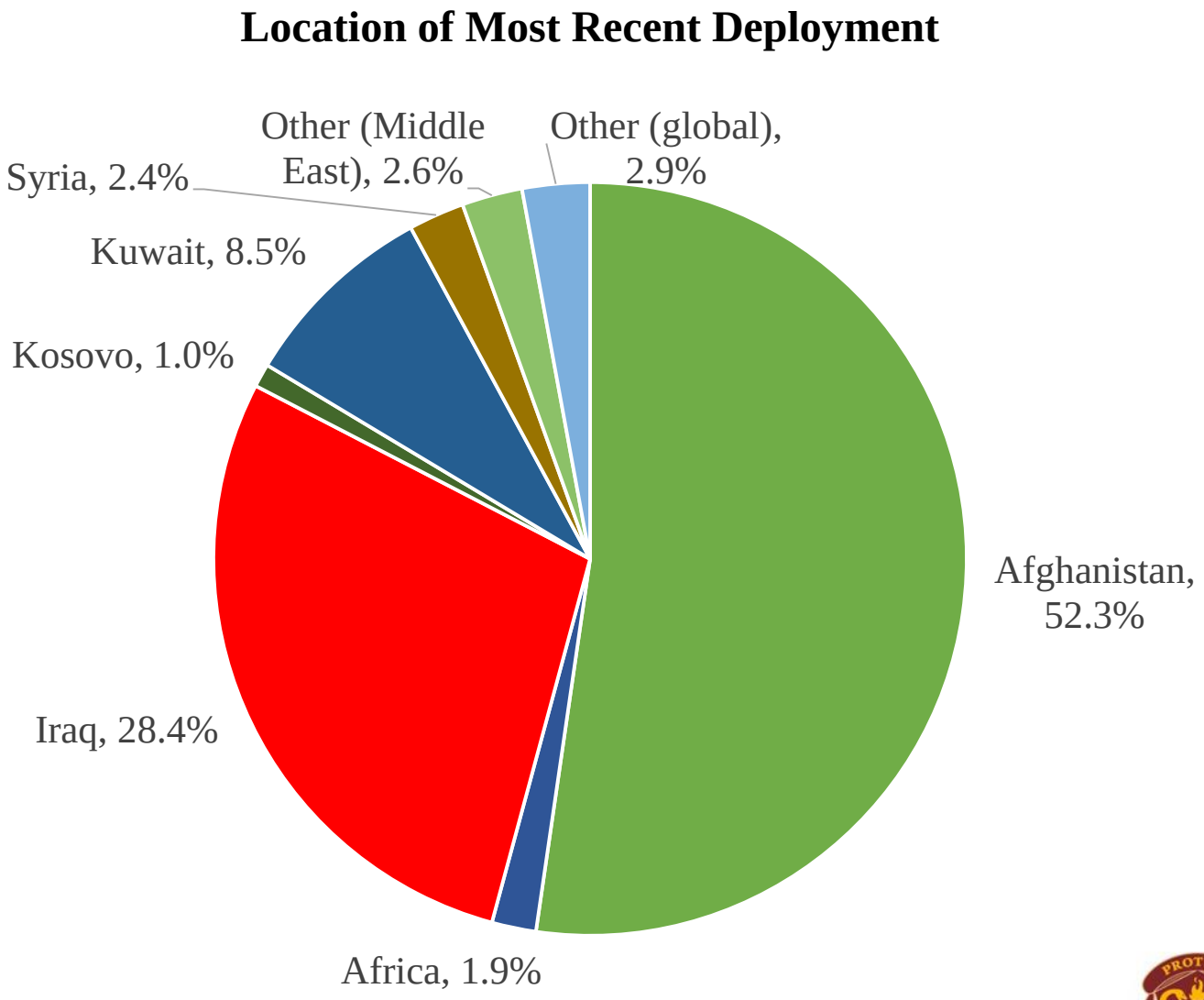
Methods

- Inclusion criteria:
  - Deployed to combat theater since 2001
  - Registered nurse or medic
    - Medical/surgical nurse
    - Emergency nurse
    - Critical care nurse
    - Nurse anesthetist
    - Licensed vocational nurse
    - Combat medic (or variants)

Results

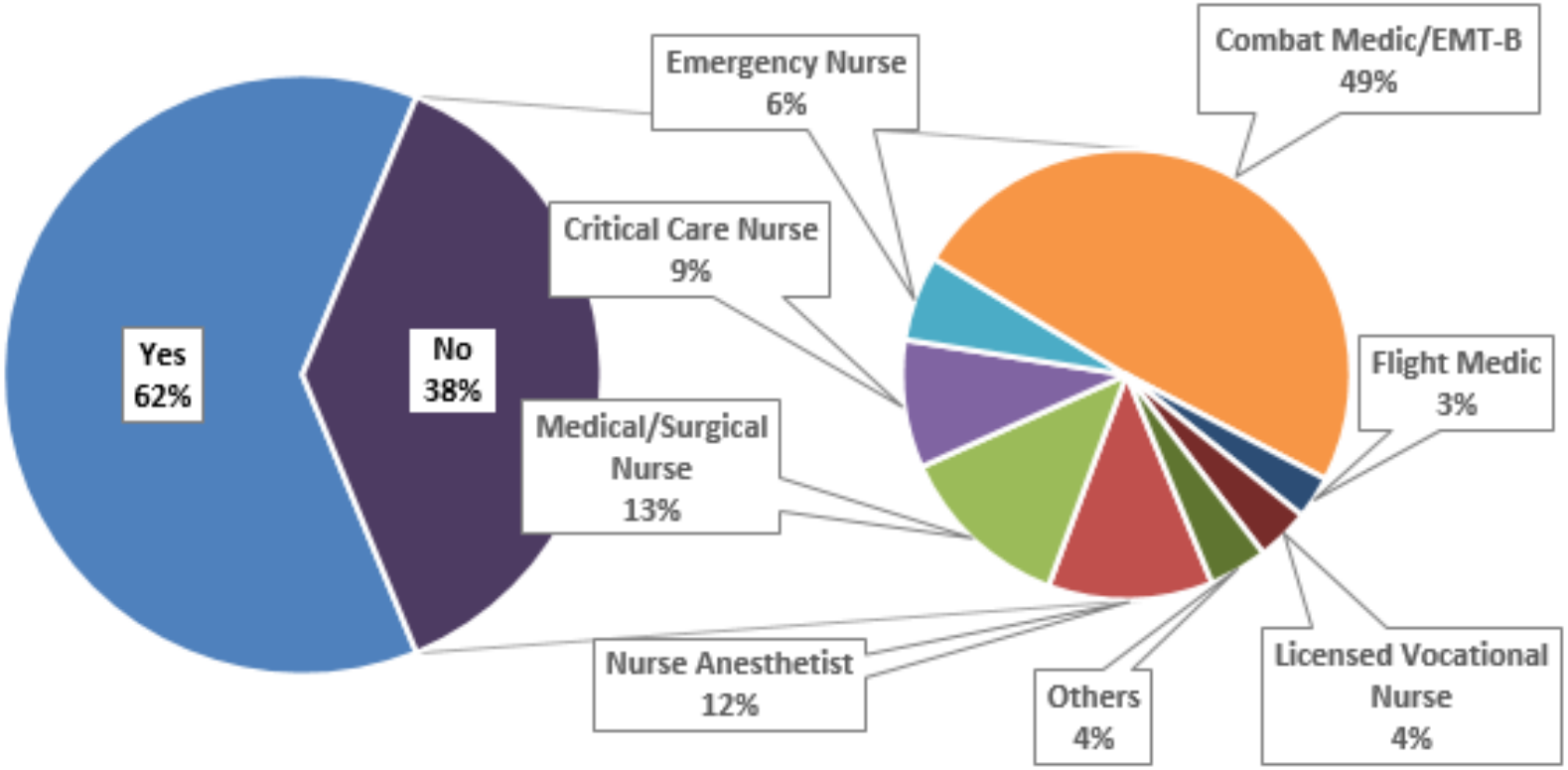
- 22,337 initial emails sent
  - 1,181 respondents (5.3% response rate)
  - 696 met inclusion criteria (58.9% of respondents)
- 73.4% (n=511) male
- 91.1% (n=634) active duty
- 45.1% (n=314) officers (Army Nurse Corps)
- Multiple deployments
  - 61.2% had 2 or more
  - 14.2% had 4 or more

Results

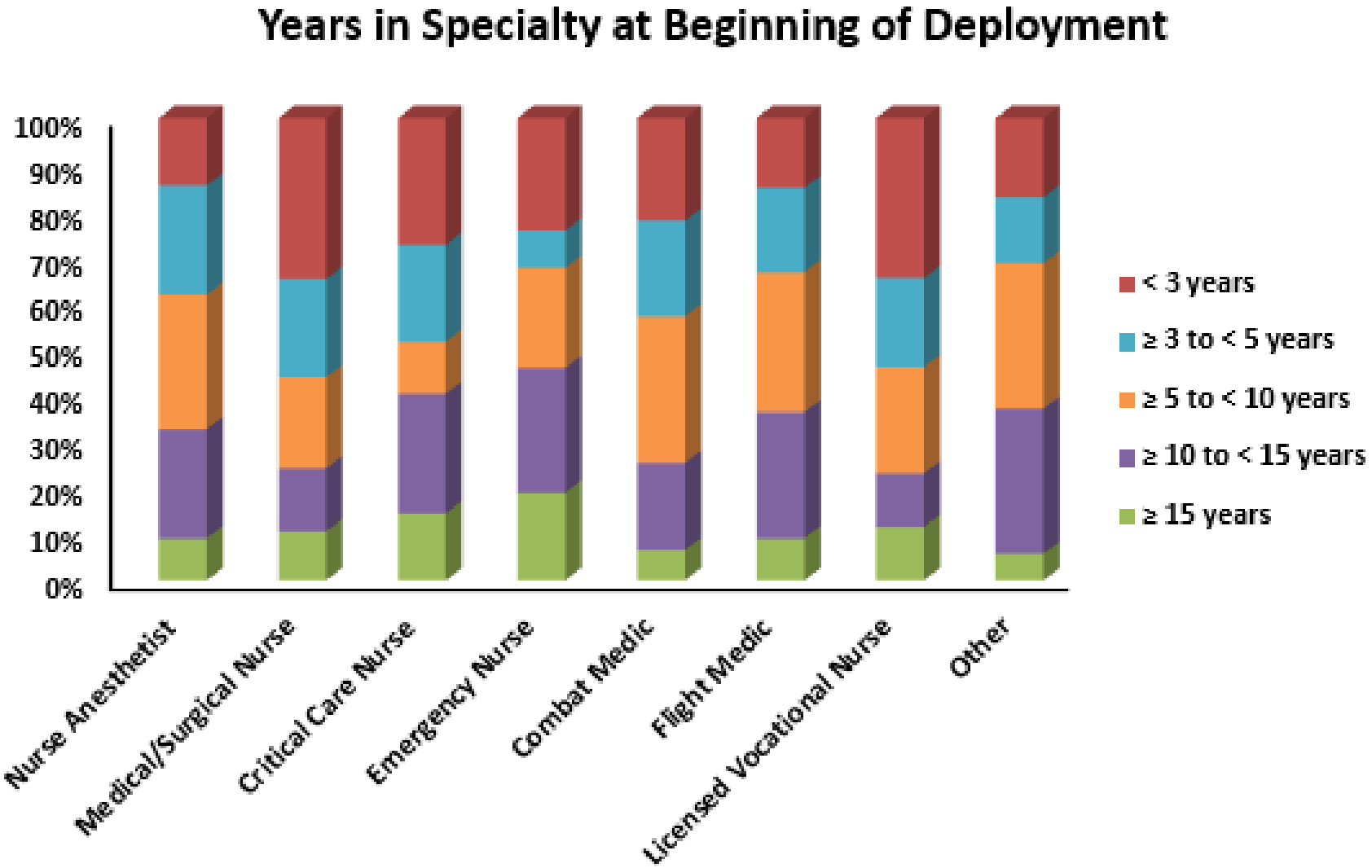

Location of Most Recent Deployment
Other (Middle East), 2.6%
Other (global), 2.9%
Syria, 2.4%
Kuwait, 8.5%
Kosovo, 1.0%
Afghanistan, 52.3%
Iraq, 28.4%
Africa, 1.9%

Results

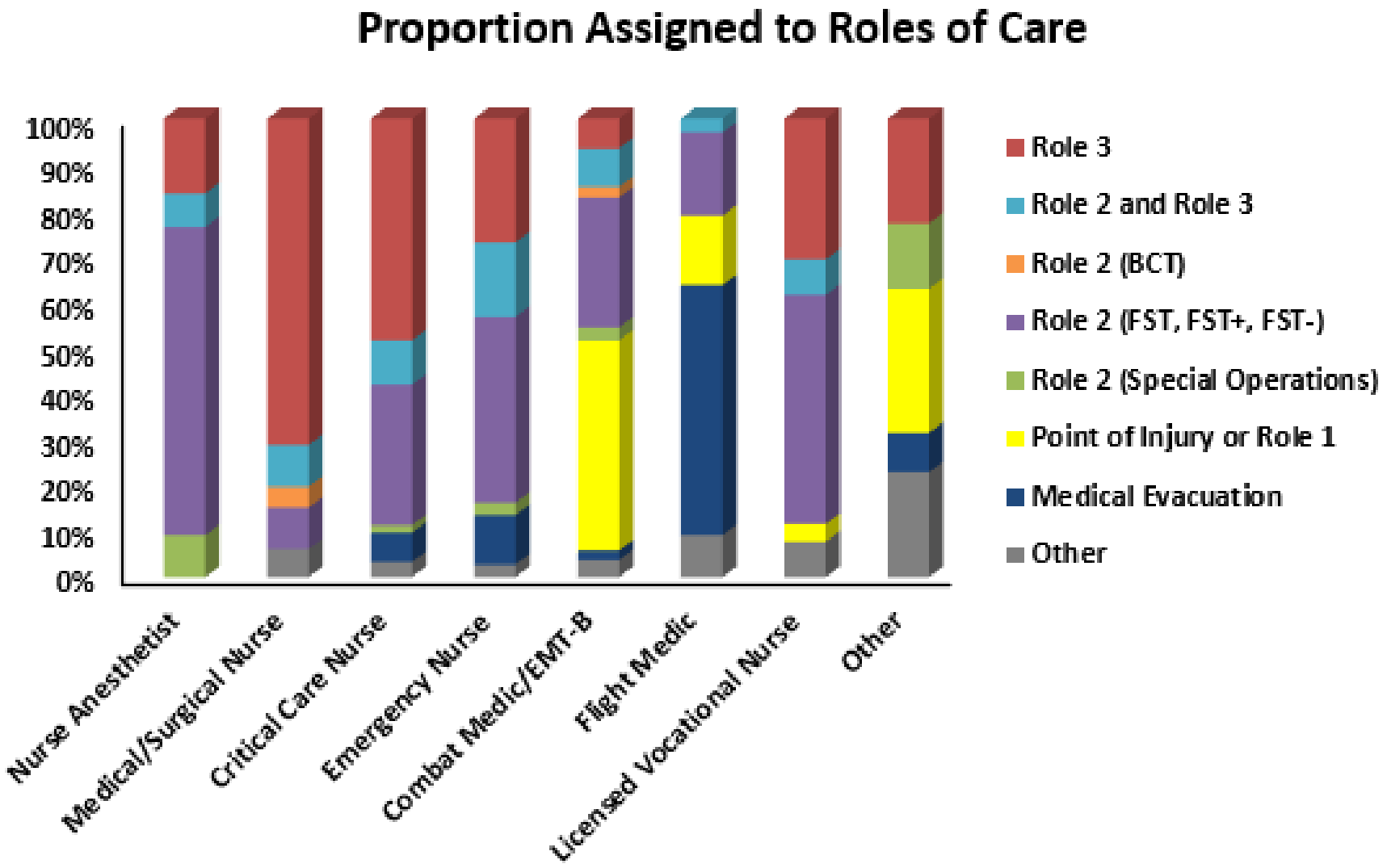
Evaluated for Clinical Competency Prior to Deployment



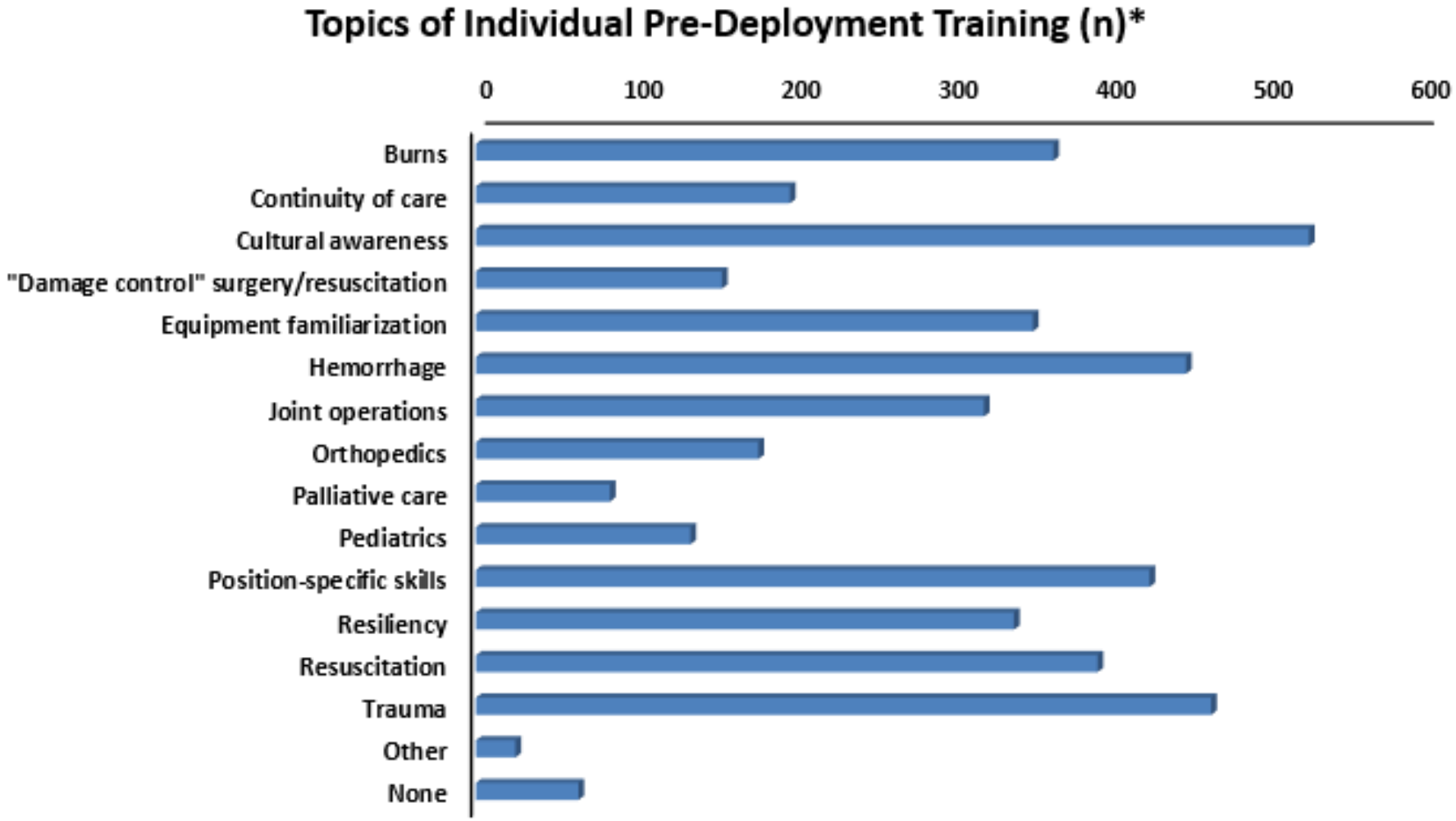
Results


Years in Specialty at Beginning of Deployment
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic
Flight Medic
Licensed Vocational Nurse
Other
< 3 years
≥ 3 to < 5 years
≥ 5 to < 10 years
≥ 10 to < 15 years
≥ 15 years

Results

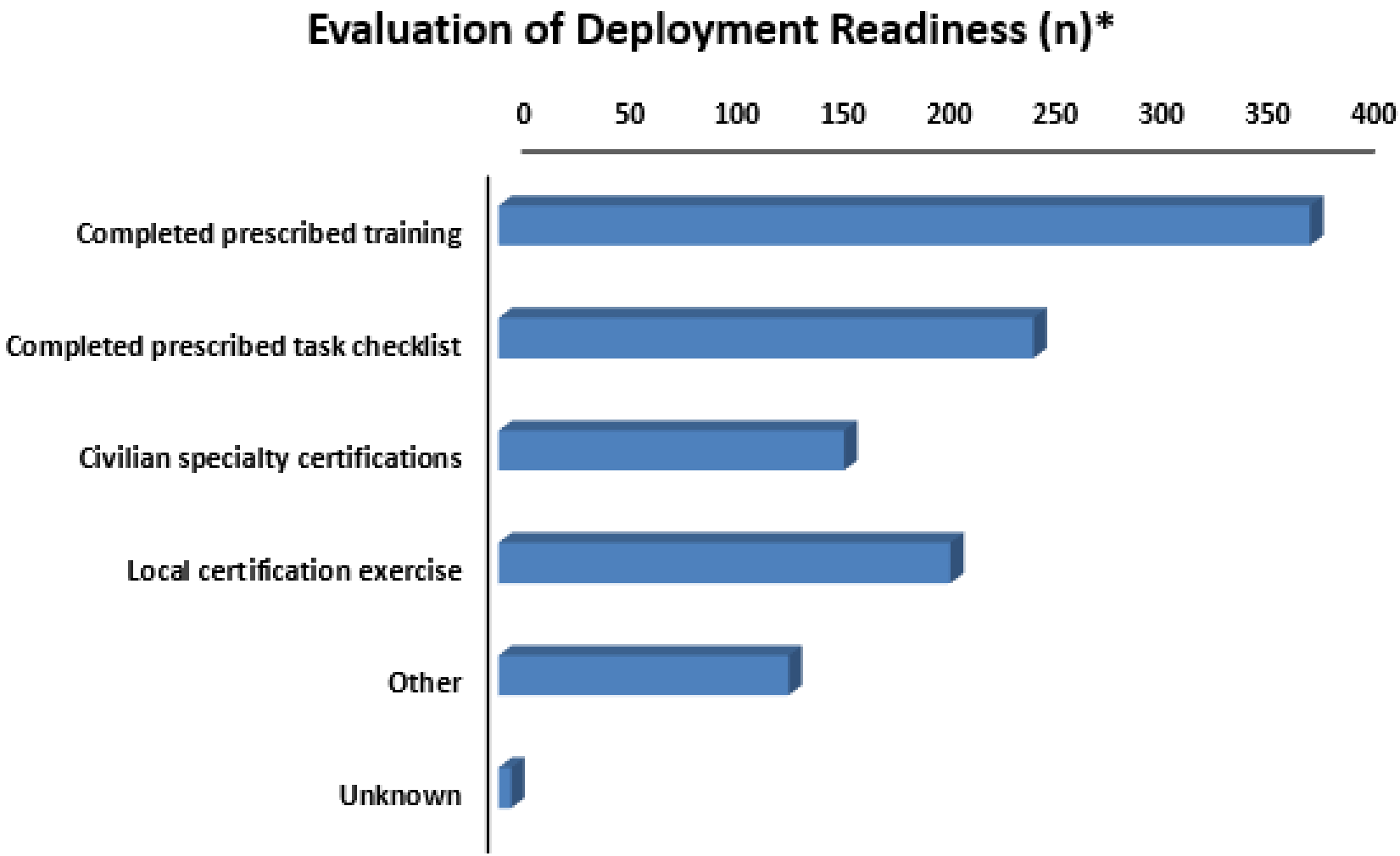

Proportion Assigned to Roles of Care
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Role 3
Role 2 and Role 3
Role 2 (BCT)
Role 2 (FST, FST+, FST-)
Role 2 (Special Operations)
Point of Injury or Role 1
Medical Evacuation
Other

Results



* - Totals may be greater than 696 because participants could select more than one option

Results



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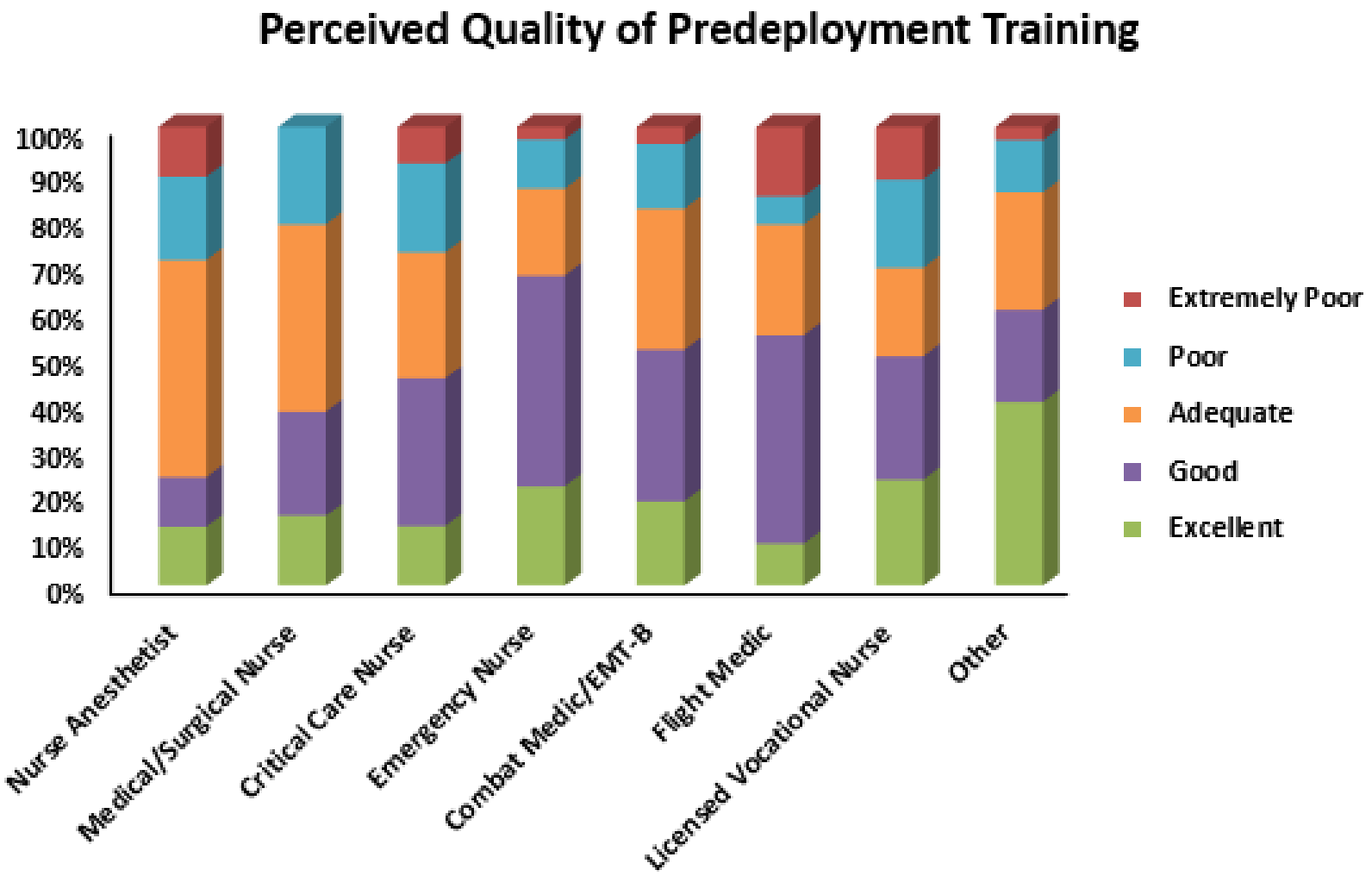
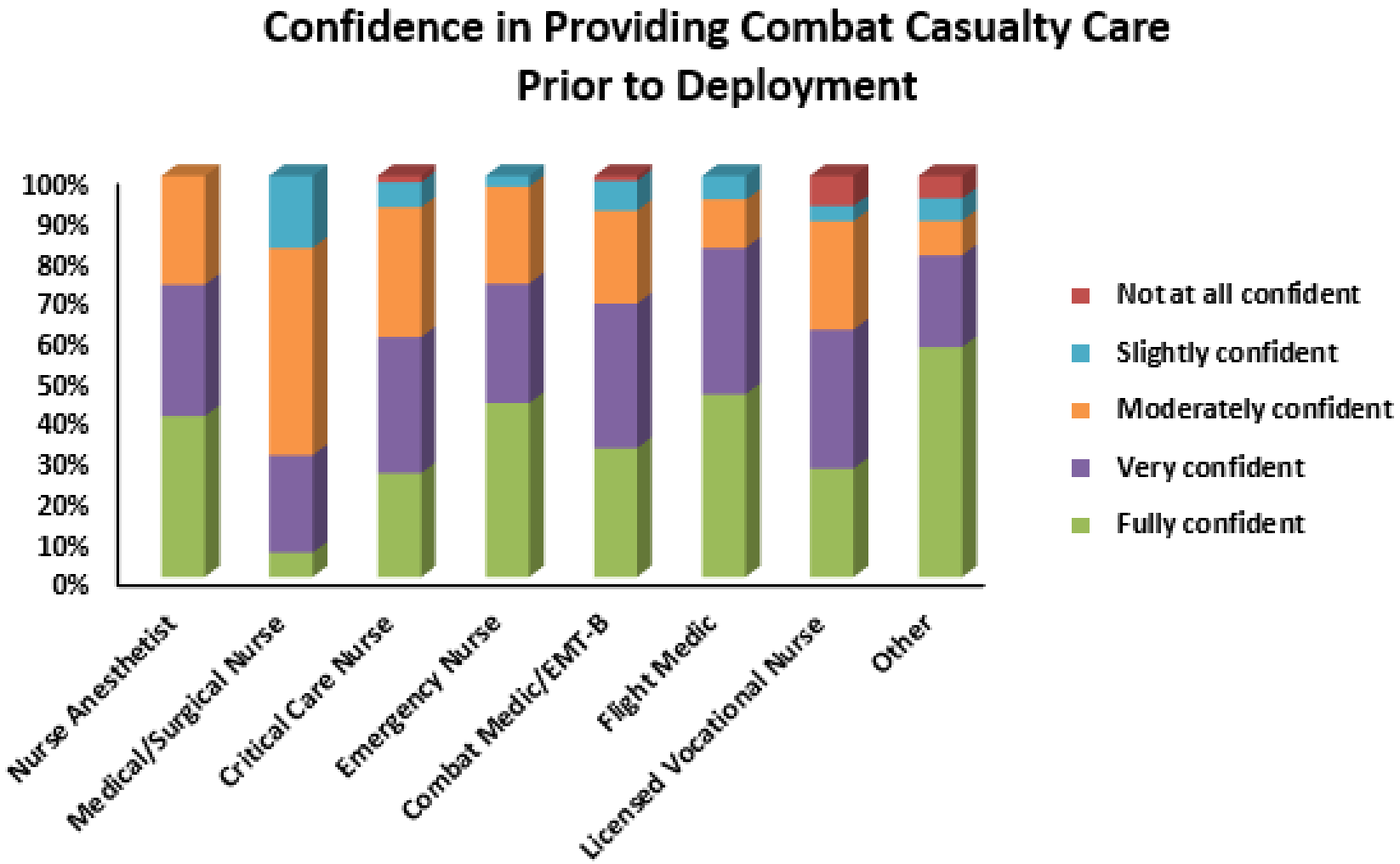
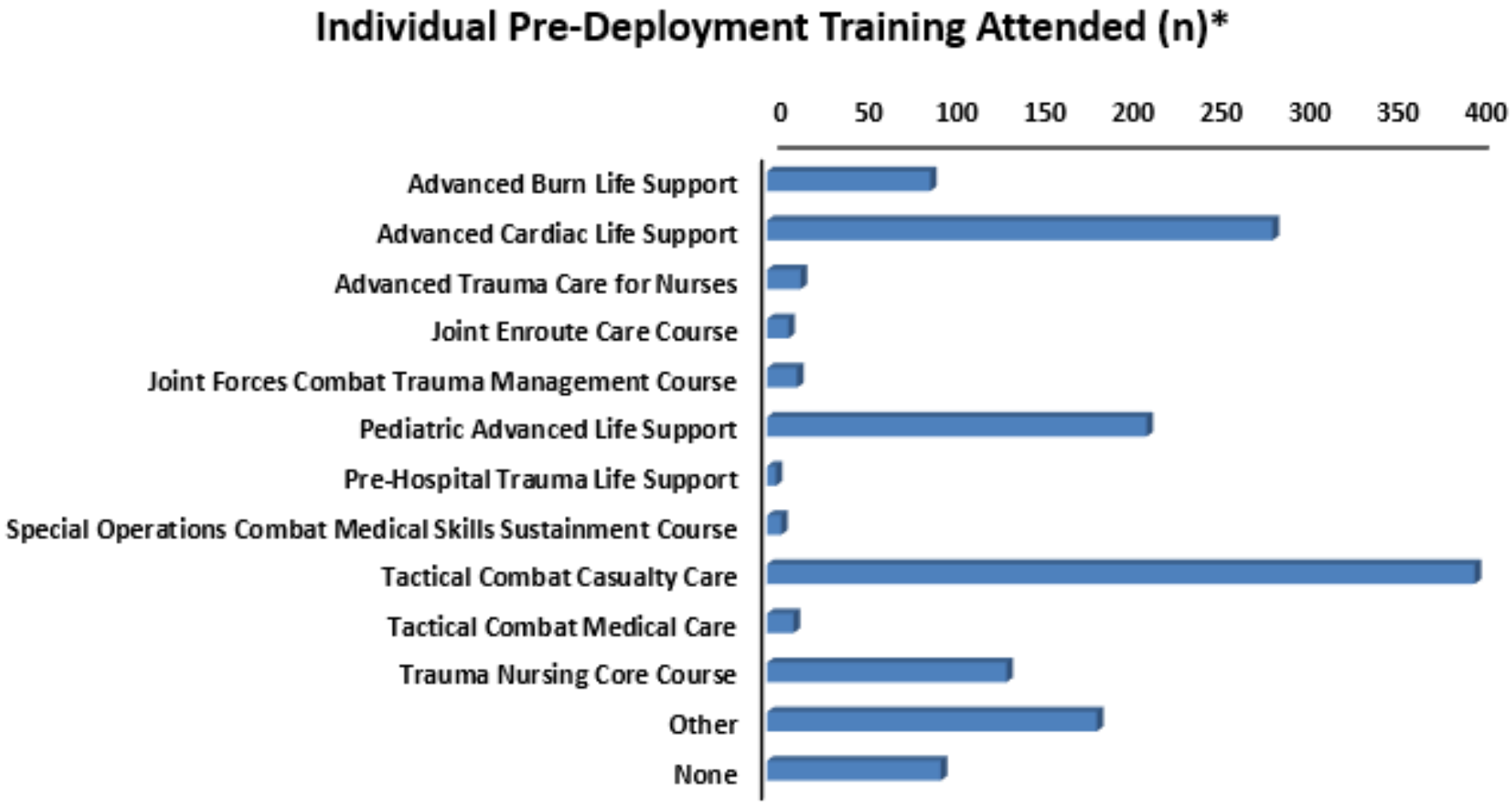
Results


Perceived Quality of Predeployment Training
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Extremely Poor
Poor
Adequate
Good
Excellent

Results

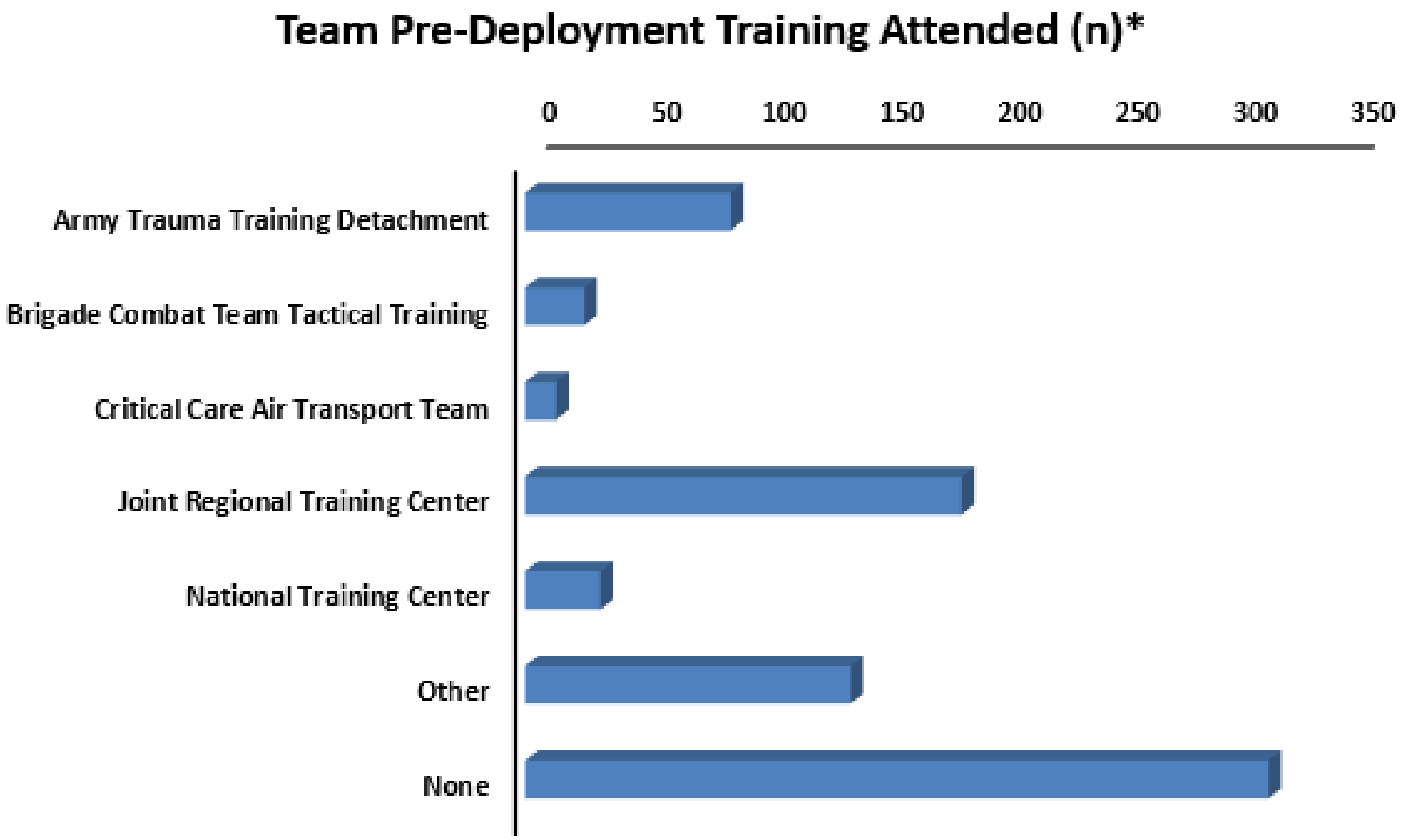

Confidence in Providing Combat Casualty Care
Prior to Deployment
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nurse Anesthetist
Medical/Surgical Nurse
Critical Care Nurse
Emergency Nurse
Combat Medic/EMT-B
Flight Medic
Licensed Vocational Nurse
Other
Not at all confident
Slightly confident
Moderately confident
Very confident
Fully confident

Results



* - Totals may be greater than 696 because participants could select more than one option

Results



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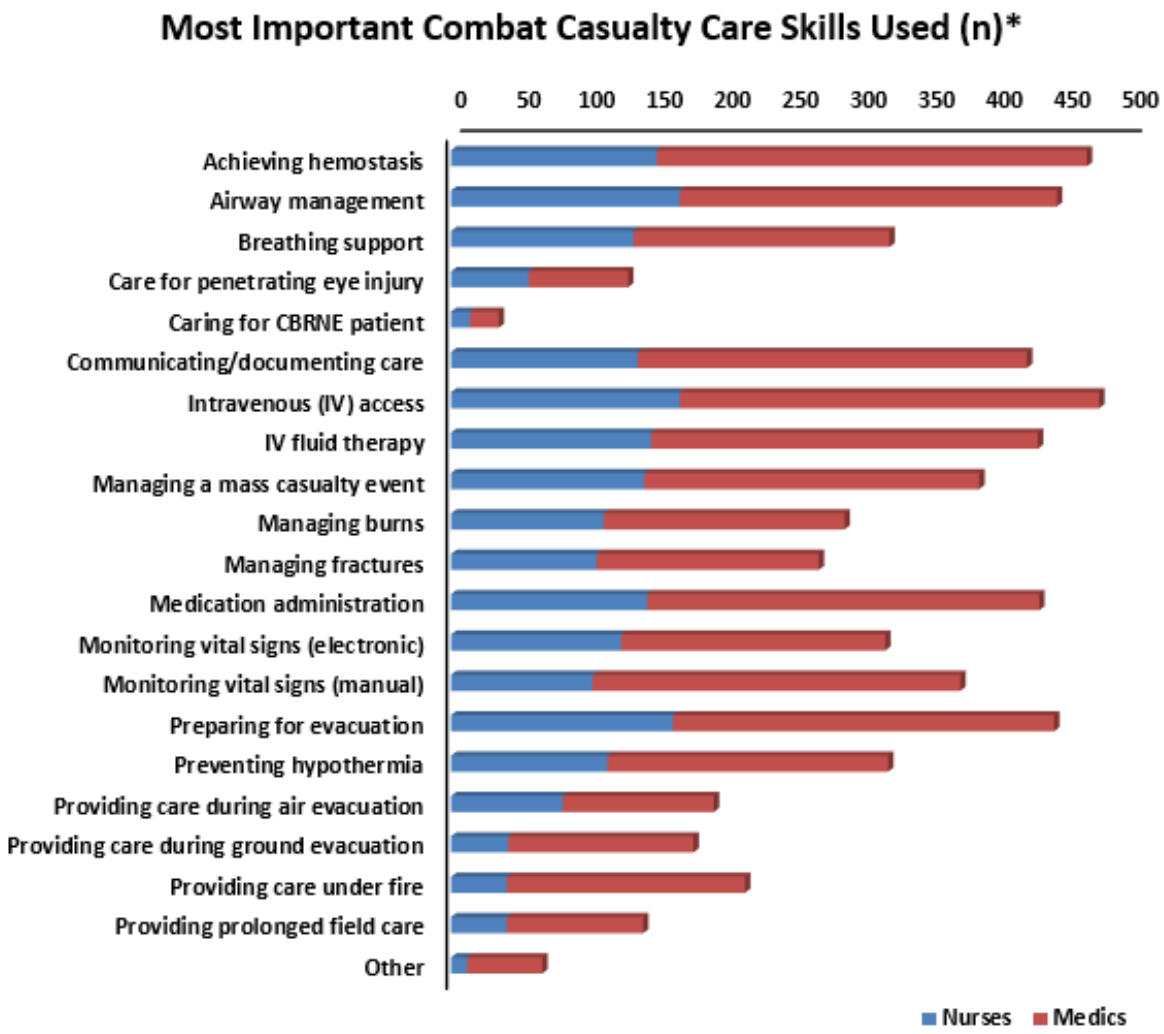
Results



* - Totals may be greater than 696 because participants could select more than one option

Results

* - Totals may be greater than 696 because participants could select more than one option

Discussion

- Most nurses and medics were satisfied with the quality of their pre-deployment training (when it occurred)
- Nurses and medics believed they were capable of providing effective combat casualty care
- Combat died of wounds rates started to rise recently, indicating that the trauma system may have previously unidentified limitations[4]
- Currently unable to link pre-deployment training to patient outcomes; success of training is subjective

Limitations

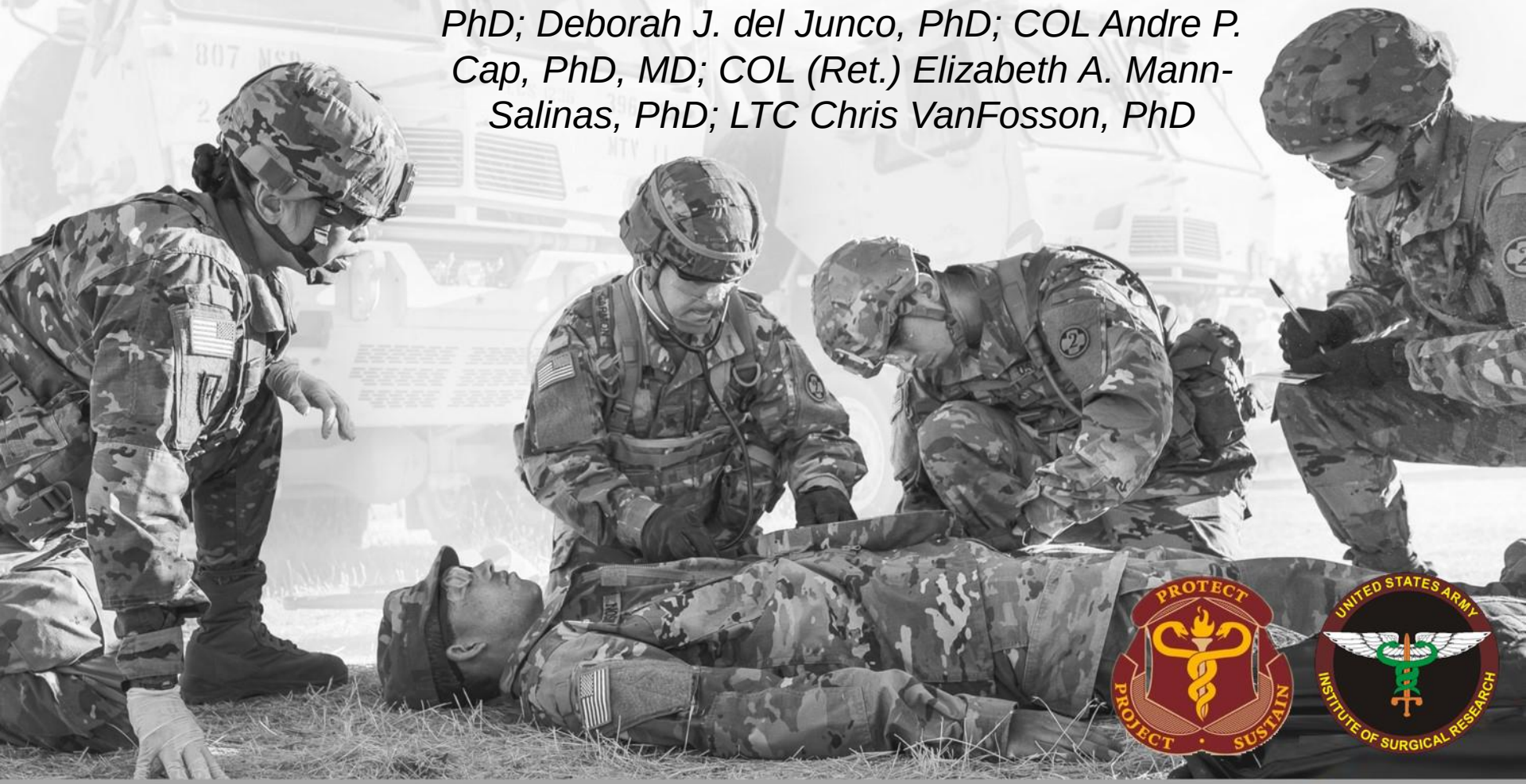
- Survey data only captured pre-deployment training for deployers and not for non-deployers
- Sample not representative of all nurse specialties

Conclusions

- Army nurses and medics felt confident and sufficiently prepared to provide trauma care during their deployments
- Increases in died of wounds rates may indicate that training was not sufficient
- To better understand the effectiveness of combat casualty care training, the Army must be able to link training events to objective measures, such as patient outcomes

Whole Blood pre-proposal idea

COL Jennifer M. Gurney, MD; Amanda M. Staudt, PhD; Deborah J. del Junco, PhD; COL Andre P. Cap, PhD, MD; COL (Ret.) Elizabeth A. Mann-Salinas, PhD; LTC Chris VanFosson, PhD



Background

- WB vs. CT
  - Observational studies inadequate adjustment [1-5]
    - Injury and hemorrhage severity
    - Time-dependency of blood transfusion
  - Controlled trials are challenging
- Association between blood type O and mortality [6]

Data sources

- DoDTR
- TMDS
- CENTCOM blood program

Study population

Inclusion Criteria

» RBC-containing blood products or plasma

» Non-missing values for key variables

Exclusion Criteria

» >20% total body surface burn

» <18 years of age

» Expectancy

» Inhalation injury

» Requiring thoracotomy prior to ER arrival

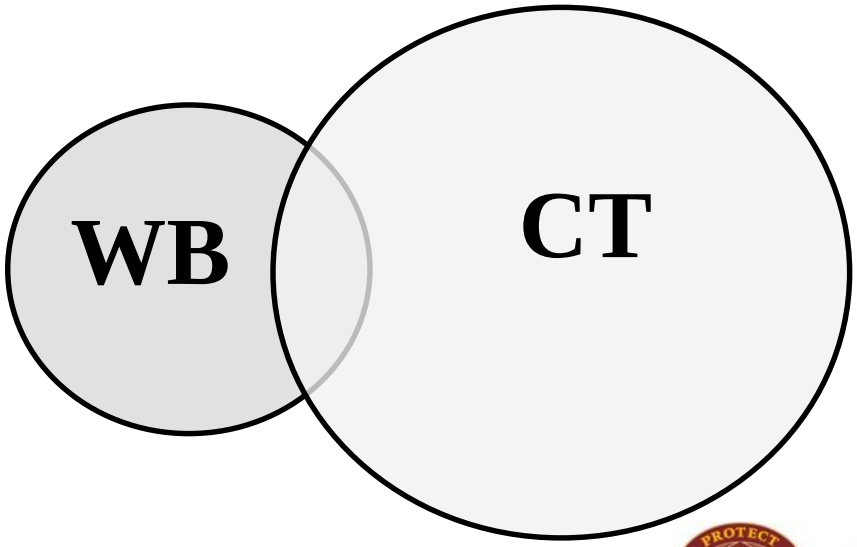
» CPR>5 minutes prior to ER arrival

Primary measures

- Exposure
  - Blood product transfusion (Aim 1 & 2)
  - ABO blood type (Aim 3)
- Outcome- Survival
  - 6 hours post injury
  - 24 hours post injury
  - 30 days post injury
- Matching factors
  - Injury mechanism and type
  - Patient affiliation
  - Tourniquet use
  - Prehospital blood transfusion
  - Admission base deficit
  - Age
  - Gender
  - Prehospital high shock risk
  - Time from injury to first surgical treatment facility arrival Severity of head injury
  - Hemorrhagic torso injury
  - Severity of traumatic limb amputation

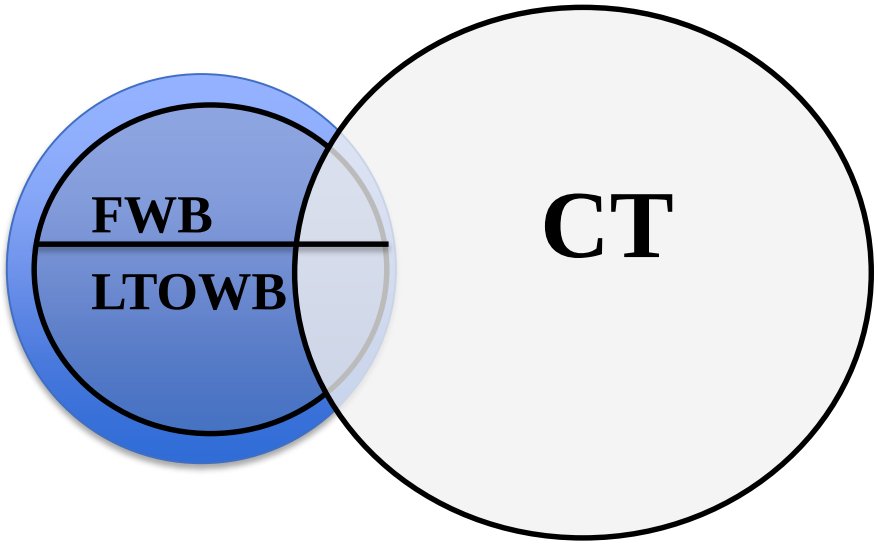
Aim 1

- To determine the association of survival at 6 hours, 24 hours, and 30 days in combat casualties who received either whole blood or red blood cells (RBCs) solely from component therapy after appropriate statistical adjustment for time-dependency of blood transfusion and bleeding severity.
  - WB vs others
  - WB dose vs no dose
  - Only WB vs 1:1:1 CT



Aim 2

» To determine differences in survival at 6 hours, 24 hours, and 30 days in combat casualties who received either fresh whole blood or low-titer O whole blood (LTOWB)



Statistical Analysis Aim 1 & 2

- Cox proportional hazards
  - Exposed recipients with the matched non-exposed recipients
  - Delayed entry approach
    - Adjust for left truncation
    - To reduce immortal time bias among transfusion recipients who were selected for analysis because they survived long enough to receive whole blood transfusion
  - Proportional hazards assumption will be assessed using the Schoenfeld residuals and log-log plots
- Survival curves
  - Each covariate will be set at its median value

Aim 3

- To evaluate differences in survival at 6 hours, 24 hours, and 30 days in combat casualties by ABO blood type
- Multivariable logistic regression

Pressure Ulcer pre-proposal idea

Shelia Savell, PhD, RN; LTC Christopher VanFosson, PhD, MHA, RN; Amanda Staudt, PhD, MPH; Mica Barba, CNS; Sarah Shingleton, CNS; Krystal Valdez-Delgado, BSN; Jennifer Trevino, MBA

Pressure Ulcers

- Occur in a localized area, typically over a bony prominence, due to pressure, shear, and/or friction
- Associated with poor outcomes
  - ↑ length of hospital stay
  - ↑ mortality rates
  - ↑ cost of care
  - ↑ pain
  - ↓ patient satisfaction
- Critically ill burn patients are a high risk population, especially BFT patients
  - ↓ movement
  - ↓ room to maneuver the patient
  - ↑ inflight stress
  - ↑ in vibration
  - Temperature changes
  - Moisture build up, ↑ friction
  - ↑ pressure due to gravitational forces

Microclimate to ↓ Pressure Ulcers

- Microclimate in a local region
  - Temperature
  - Moisture (relative humidity)
  - Airflow experienced
- In 2014, National Pressure Ulcer Advisory Panel CPG recommended microclimating
- New type of medical device called **<u>specialty linens</u>**
  - FDA approved
  - Wicks away moisture faster, smoother, cooler, antimicrobial coating
  - Positive clinical findings
    - Cardiovascular and surgical: 5.2% → 2.8%
    - Telemetry, Urology, & ICU: 10.3% → 2.5%
    - Medical renal and surgical: 17% → 4.5%

Aim 1

- Evaluate use of a specialty linen on occurrence of posterior pressure ulcers during a 36-month period in burn patients
  - Pre-implementation: 18 month data collection period
  - Post-implementation: 18 month data collection period
  - Pre-specified secondary analysis on military casualties transported by the Army Burn Flight Team and admitted into the USAISR Burn Center

?

Methods

- All USAISR Burn Center and US Army Burn Flight Team patients
  - 600 USAISR Burn Center burn patients/year
  - 10-25 Burn Flight team patients/year
- Exposure
  - Cotton blend bed linens (non-exposure)
  - Silk-like specialty bed linen (exposure)

Outcome

- Pressure ulcer formation incidence rate (multiple pressure ulcer formations/patient) ?
- Measurements
  - National pressure ulcer advisory panel grading scale USAISR Burn Center
  - Include all stages
  - Burn center patients
    - within 72 hours
    - Weekly
  - BFT patients
    - 24-48 hours
    - 3 days post transport
    - Weekly
  - Evaluated until a patient is discharged or can independently ambulate

Sample size

Table 1. Sample sizes for 80%, 85%, and 90% power for two-sided type 1 error rate of 0.05 with excessive, moderate and conservative differences

Difference	Sample size per arm		
	80% Power	85% Power	90% Power
2.4	1046 ?	1196	1399
7.8	154	176	205
12.5	96	109	127

Aim 2

- Modify the Braden scale for predictive use in burn patients
  - Used to evaluate the patient's risk of pressure ulcers
  - Not developed for burn patients
  - Modify score for the burn patient population
    - Logistic regression
      - Prediction model
      - Weighted scoring system
    - Evaluated with sensitivity and specificity

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Acknowledgements

This work was supported by the Assistant Secretary of Defense for Health Affairs through the Defense Medical Research and Development Program under Award No. W81XWH-15-2-0085.

The authors acknowledge the Joint Trauma System Role 2 Database for providing data for this study

*This work was supported by the TOSR team (**Jennifer Trevino, Krystal Valdez-Delgado, Mithun Suresh, Nicole Caldwell, Tricia Garcia-Choudary, Amanda Staudt, LTC Chris VanFosson, Elizabeth Mann-Salinas**), Jennifer Gurney, Frank Butler, and Russ Kotwal*

Questions?


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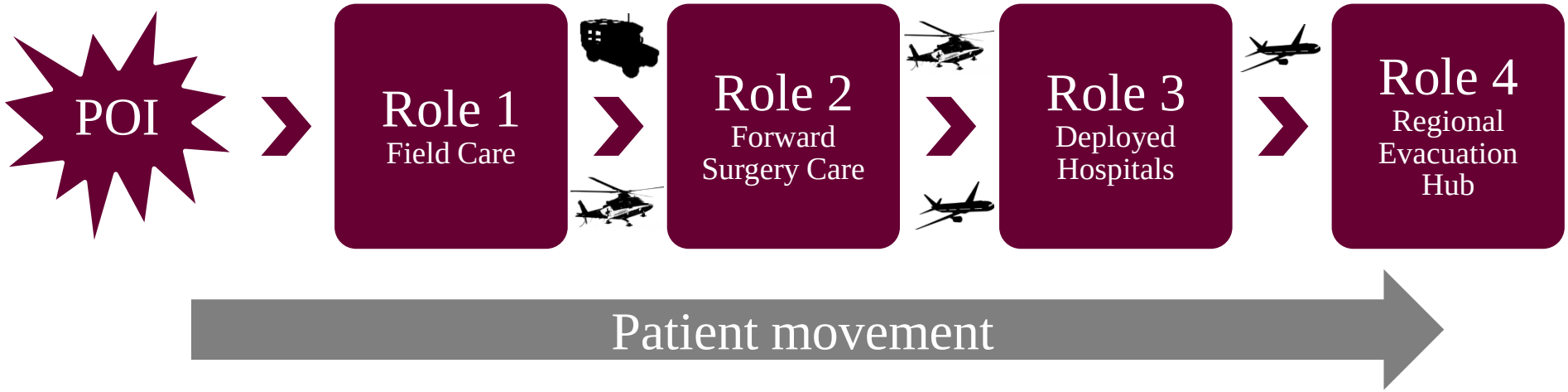
Supplemental

ICD-9-CM Code	Description	Count	Percent
Exploratory laparotomy	Laparotomy, Exploratory	444	100.0
Vascular procedures other than head and neck		228	100.0
	Ligation, Blood Vessels	118	51.3
	Repair, Blood Vessel with suture or tissue patch graft	51	22.2
	Graft, Blood vessel	21	9.1
	Suture (laceration), Vein	16	7.0
	Suture (laceration), Artery	15	6.5
	Control, hemorrhage	7	3.0
Debridement	Debridement	577	100.0
External fixator	External fixator	423	100.0
Thoracotomy	Thoracotomy	60	100.0
Resection, Repair, Suture, or incision of large or small intestine, duodenum, or colon	Resection, Repair, Suture, or incision of large or small intestine, duodenum, or colon	110	100.0
Suture of liver, abdominal wall, pancreas, or omentum; Laparotomy NEC; Pancreatectomy; Groin Exploration		86	100.0
	Suture (laceration) of liver, abdominal wall, pancreas, or omentum; Laparotomy NEC, Pancreatectomy	54	62.8
	Exploration, Groin	32	37.2
Amputation of lower extremity	Amputation, Disarticulation	199	100.0
Therapeutic procedures on muscles and tendons		445	100.0
	Fasciotomy	239	53.5
	Debridement, muscle	114	25.5
	Removal, Foreign body, Soft tissue	58	13.0
	Suture, Fascia or Muscle	18	4.0
	Other[a]	16	3.6
Debridement of open fracture, internal fixation, or reduction to lower extremity (other than hip or femur)		202	100.0
	Debridement, Open fracture	172	80.8
	Fixation, Internal	20	9.4
	Reduction	10	4.7

Resection of large intestine	Resection of large intestine	58	100.0
Splenectomy	Splenectomy	42	100.0
Debridement of open fracture, internal fixation, or reduction to hip and femur		78	100.0
	Debridement, Open fracture	52	66.7
	Fixation, Internal	14	17.9
	Reduction	12	15.4
Cardiopulmonary resusitation, pericardial window	Cardiopulmonary resusitation, pericardial window	13	100.0
Debridement of open fracture, internal fixation, or reduction to radius and ulna		139	100.0
	Debridement, Open fracture	118	84.9
	Fixation, Internal or reduction	21	15.1
Skull and brain procedures		25	100.0
	Craniotomy, Burr holes, Foreign body removal in skull or brain	14	56
	Skull debridement, Craniectomy	11	44
Amputation, Disarticulation of upper extremity or unspecified	Amputation, Disarticulation of upper extremity or unspecified	68	100.0
Arthrotomy	Arthrotomy	86	100.0
Exploration, neck	Exploration, neck	85	100.0
Suture of diaphragm or lung, Trachea repair	Suture of diaphragm or lung, Trachea repair	36	100.0
Debridement of open fracture, internal fixation, or reduction to humerus, hand or unspecified		171	100.0
	Debridement, Open fracture, upper extremity or unspecified	122	69.7
	Fixation, Internal, upper extremity or unspecified	41	23.4
	Reduction, upper extremity or unspecified	8	4.6
Nephrectomy	Nephrectomy	23	100.0
Lung Lobectomy, Lung resection	Lung Lobectomy, Lung resection	10	100.0
Exam of Eye Under Anesthesia	Exam of Eye Under Anesthesia	19	100.0
Canthotomy, Canthoplasty	Canthotomy, Canthoplasty	9	100.0
Arterial bypass	Bypass, arterial	15	100.0
Stomach suture	Suture, stomach	12	100.0
Debridement of open facial fracture	Debridement, Open fracture, Facial	24	100.0
Orchiectomy, Penis Suture, Scrotum repair	Orchiectomy, Penis Suture, Scrotum repair	15	100.0
Colostomy	Colostomy	12	100.0
Suture of bladder, ureter, or kidney	Suture of bladder, ureter, or kidney	8	100.0
Small intestine resection	Resection, small intestine	6	100.0

Combat continuum of care

Continuum of Care



Role 1- Field Care

- Providers
  - Self/buddy aid
  - Combat lifesaver
- Capabilities
  - First aid
  - Lifesaving measures
- TCCC
  - Care Under Fire
  - Tactical Field Care
  - Tactical Evacuation Care

Role I- Battalion Aid Station

- Providers
  - Physician assistant
  - Medic
- Capabilities
  - Triage
  - Life saving treatment
  - Stabilization for evacuation
  - ~~Surgical capability~~
  - ~~Patient holding~~

Transport Type

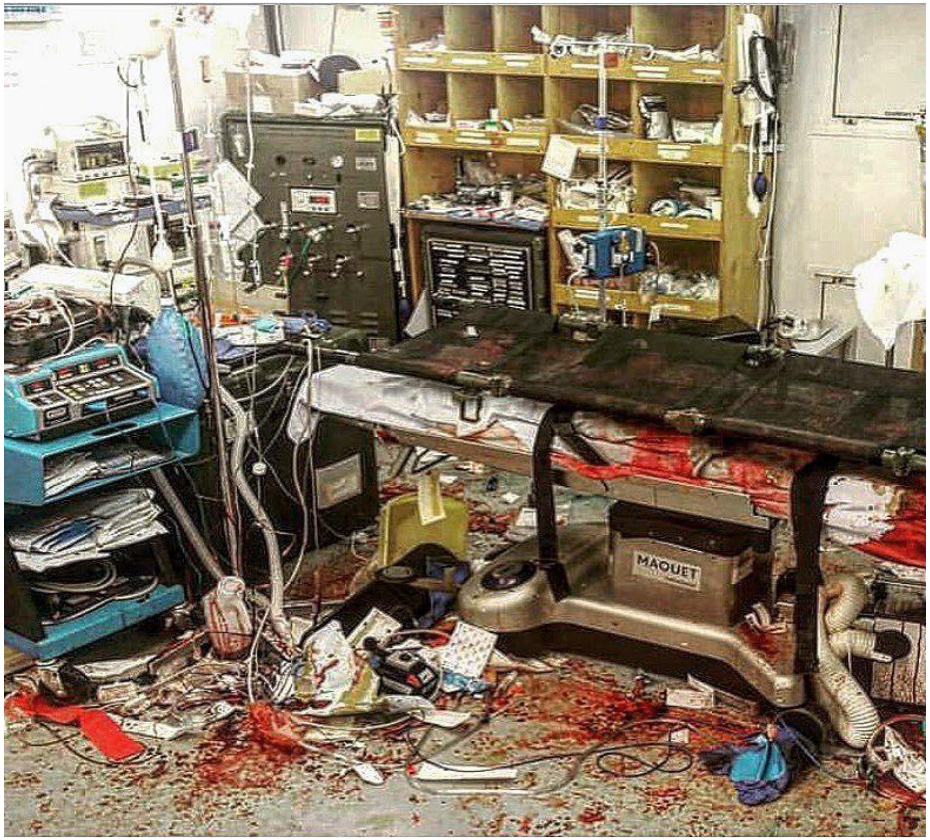
	MEDEVAC	CASEVAC
Regulated	✓	✗
Dedicated hospital patient transfer	✓	✗
Medical personnel	✓	?
Medical equipment	✓	?
En route care	✓	?

Summary of Role 2 Transport Type

- MEDEVAC Air transported the most patients
- CASEVAC Air
  - Transported a small portion of patients
  - Highest percent of KIA patients
  - Shortest transport time
- Importance of training all deployed personnel in TCCC

Role 2- Forward Surgery Care

- Providers
  - Surgeons
  - Nurse anesthetists
  - Critical care/ER nurses
  - OR nurse
  - Techs
- Capabilities
  - Damage control surgery
  - Damage control resuscitation
  - Limited patient hold
- Median length of stay: 2.5 (IQR=1.2, 5.5) hours



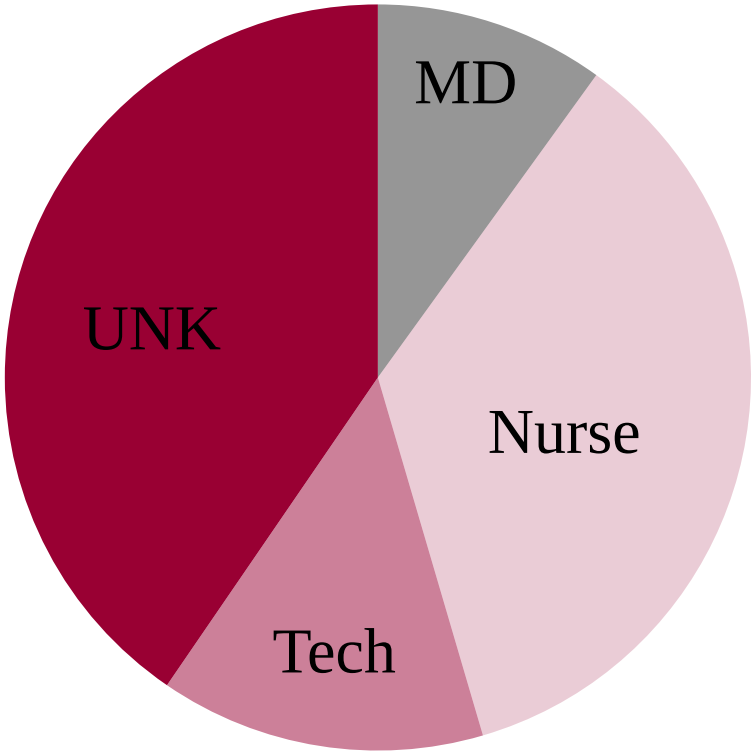
Transport from Role 2 to Role 3

- Fixed-wing planes or helicopters
- Capabilities
  - Vasopressors
  - Blood
  - Definitive airway
- Providers
  - Paramedic
  - Medic
  - Critical care provider

En route care from Role 2 to 3

- Diagnosis:
  - 38.6% orthopedic injury
  - 23.9% soft tissue trauma
- At transfer:
  - 26.9% intubated
  - 1.6% vasopressors
  - 7.4% temporary chest closure
  - 5.2% pH < 7.3
  - 3.5% base deficit > 5

Highest level of en route medical attendant



Role 3- Deployed Hospitals

- Combat support/field hospital
- Highest level of care in theater
- Capabilities
  - Blood banking
  - Advanced imaging
  - Full laboratory
- Ancillary services
  - Rehabilitation
  - Nutrition support
  - Outpatient care

Trauma Bay

Role 3- Deployed Hospitals

- Full-spectrum trauma care providers
  - Neurosurgery
  - Vascular surgery
  - Definitive orthopedic surgery
- Extended patient hold
- Extended ICU holding capability

Operating Room

Transport from Role 3 to Role 4

» In Vietnam, casualties remained in theater for 21 days

» Most critically injured casualty remain in theater <28 hours

Transport from Role 3 to Role 4

	CCATT	AE
Flying ICU	✓	✗
MD	✓	✓
Nurse	✓	✓
RT	✓	✗

Aeromedical Evacuation Challenges

- Heavy equipment
- ↑ number of patients
- Unstable physiology in early post-trauma patients
- Limited patient access
- Noise limits diagnostic capabilities
- Providers
  - Fatigue
  - Variation of clinical skills

Role 4- Regional Evacuation Hub

- All specialties
- Capabilities:
  - Full spectrum of care
  - Complex surgical care
- Fixed facility trauma center
- OCONUS or CONUS

Role 2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What is a Role 2?

MILITARY MEDICINE, 182, 3/4:32, 2017

The Afghan Theater: A Review of Military Medical Doctrine From 2008 to 2014

Col Ian Lane, L/RADC; CAPT Zsolt Stockinger, MC USN†; COL Samual Sauer, MC USA†; Col Mark Ervin, USAF MC‡; COL Michael Wirt, MC USA§; Surg Capt Stephen Bree, RN‖; COL Kirby Gross, MC USA¶; Col Jeffrey Bailey, USAF MC**; Brig Timothy Hodgetts, L/RAMC††; COL Elizabeth Mann-Salinas, AN USA§*

- Variation in terminology
- Confusion over “Role 2”
- US Army is the ONLY service/partner to NOT consider Role 2 the first surgical capability on the battlefield

Role 2

- Critically injured causalities require timely care[1]
- Reduce time to between injury and surgical care:
  - Forward positioned surgical teams[2,3,4]
  - Increase number and dispersion of surgical teams[1]
  - “Golden hour” mandate[1]




Role 2 Facilities by Region, 2008-2014