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Innovative Development of Evidence-Based, Medical Evacuation Clinical Practice Guidelines and Novel Validation of the Current Critical Care Air Transport Team Clinical Practice Guideline

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14. ABSTRACT
There are many variables for en route care either by aeromedical evacuation or Critical Care Air Transport Teams. One variable that can complicate provided care is the ability to maintain evidence-based clinical practice guidelines (CPGs). With the amount of research being performed and results that could change/impact care being provided, it is imperative to review relevant CPGs from the Joint Trauma System (JTS) to look for gaps specific to the en route care phase and to develop a process to collect/evaluate these findings and, if necessary, apply them to current CPGs. Our study attempted to create a review process to help minimize the potential gap between current research findings and CPGs. Our first step in the project was to develop a central website that was to serve as a communication platform, data transfer point, and voting center. The second phase was to recruit volunteer subject matter experts (SMEs) to establish keywords for literature searches, review current literature, and discuss possible recommendations through a discussion board on the website for CPG changes based on findings. If an addendum to the CPG was agreed upon by the assigned team, it would be written and voted on by a quorum of SME review teams. The third phase involved the addendum to be voted on by the owning community; if adopted, it would be posted to the U.S. Army Institute for Surgical Research/JTS site. A website was created and 33 SMEs volunteered to support the effort. One issue with the website and the volunteer SMEs was access to the website was limited due to firewalls; this required the SMEs to oftentimes access from home networks. In the end we learned a valuable lesson. While we could harness some great inputs from such a wide cast for SMEs, the downside was follow-through. As a research cell, we had no way to push for closure once projects were assigned to the volunteers. Follow-through became an increasing problem as we moved forward, with more and more resources dedicated to just getting responses on outstanding reviews. The website worked very well aside from some firewall-related issues. The system allowed a central research cell to do all the relevant literature searches once keywords were provided by an assigned SME team. The project did result in five recommended changes to the JTS.

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1.0 SUMMARY

There are many variables for en route care either by aeromedical evacuation or Critical Care Air Transport Teams. One variable that can complicate provided care is the ability to maintain evidence-based clinical practice guidelines (CPGs). With the amount of research being performed and results that could change/impact care being provided, it is imperative to review relevant CPGs from the Joint Trauma System (JTS) to look for gaps specific to the en route care phase and to develop a process to collect/evaluate these findings and, if necessary, apply them to current CPGs. Our study attempted to create a review process to help minimize the potential gap between current research findings and CPGs. Our first step in the project was to develop a central website that was to serve as a communication platform, data transfer point, and voting center. The second phase was to recruit volunteer subject matter experts (SMEs) to establish keywords for literature searches, review current literature, and discuss possible recommendations through a discussion board on the website for CPG changes based on findings. If an addendum to the CPG was agreed upon by the assigned team, it would be written and voted on by a quorum of SME review teams. The third phase involved the addendum to be voted on by the owning community; if adopted, it would be posted to the U.S. Army Institute for Surgical Research/JTS site. A website was created and 33 SMEs volunteered to support the effort. One issue with the website and the volunteer SMEs was access to the website was limited due to firewalls; this required the SMEs to oftentimes access from home networks. In the end we learned a valuable lesson. While we could harness some great inputs from such a wide cast for SMEs, the downside was follow-through. As a research cell, we had no way to push for closure once projects were assigned to the volunteers. Follow-through became an increasing problem as we moved forward, with more and more resources dedicated to just getting responses on outstanding reviews. The website worked very well aside from some firewall-related issues. The system allowed a central research cell to do all the relevant literature searches once keywords were provided by an assigned SME team. The project did result in five recommended changes to the JTS.

2.0 BACKGROUND

The original intent of this study was to use a novel task-saturated simulation environment to determine the compliance of Critical Care Air Transport Team (CCATT) members with the ventilation management clinical practice guidelines (CPGs), areas of human error, and areas for CPG improvement in an effort to identify the baseline compliance to CPGs of CCATT members and propose a new approach to CPG validation, development, and simplification.

Even the best evidence-based CPG is limited if providers are not willing or able to consistently comply with the CPG. In the task-saturated environment of en route care (ERC), this ability may be substantially less than within the confines of a hardened, modern intensive care unit. CPGs written for ERC may require a significantly simplified algorithm to ensure compliance. The purpose of our proposed study was to improve ERC by identifying the baseline ability of CCATT members to comply to current CPGs and examine new ways to develop and validate simplified CCATT CPGs.

The research completed four teams of simulations; the research team realized that simulation evaluation is not the proper system for evaluating CPGs and clinical relevance. During the 2016 Joint En Route Care Committee meeting, a change in scope was discussed. A scope change was approved from sim validation of mechanical ventilation to the idea of

reviewing all CPGs for possible updating via literature/findings utilizing volunteer subject matter experts (SMEs), the Air Force Center for the Sustainment of Trauma and Readiness Skills cadre at the University of Cincinnati (UC), and a UC research team. The scope of the reviews was limited to an evaluation of implementation gaps relevant to the ERC phase. This was not to be a full revision of any CPG, as that task is the sole responsibility and authority of the Joint Trauma System (JTS).

3.0 METHODS

The phases of the re-scoped project included the following actions:

1. Create a CPG website
2. Gather volunteer SMEs
3. Assign SME teams to review CPGs to identify keywords for literature search
4. Assign UC research team to conduct a literature search and post results to the website
5. Have assigned SMEs conduct a review and discuss possible recommendations through discussion board on the website for CPG changes based on findings
6. If an addendum to the CPG was agreed upon by the assigned team, have a quorum of SME review teams write and vote on the CPG
7. If agreed upon, have the owning community vote on the addendum
8. If adopted, post the addendum on the U.S. Army Institute for Surgical Research/JTS site

4.0 RESULTS

The first two phases of the re-scoped project went on schedule and appeared very promising. A website was developed, www.enroutecarecpg.com, that allowed secure yet easily accessible communication between teams and the central research team. The site was designed with upload and chat room capabilities to remove communication burdens from the volunteer SMEs. The initial response from the field of ERC experts was encouraging. Thirty-three members were selected from the recruited pool to start the first phase of reviews. Only a small portion of the CPGs were initially sent for review to test the website and processes with a smaller volume.

The results from the first wave were disappointing. The SMEs were divided into nine teams reviewing nine CPGs. Only three teams returned a list of keywords for the literature search to be completed by the central research team. Initial communication with the teams through the site was supplemented by team-directed emails, then individual emails. Despite continued efforts on this first attempt, only one CPG reached the stage of suggested edits, and one additional review was completed with a recommendation of no edits needed.

Additional CPGs were assigned in waves with realignment of SMEs on the teams to facilitate interactions as best as possible across the force of volunteers. Recruitment was expanded with only a few additional respondents. Members who did not actively affirm a desire to continue to participate were not assigned any further reviews. Further review results were equally disappointing, with each successful review being completed by a single member of a team, usually with no apparent input from the other SMEs on that particular panel.

Literature reviews were completed by paid research staff. Keyword search results varied significantly, with as many as 49 articles being returned for a single CPG. In an effort to avoid

overwhelming the panels, the principal investigator (PI) reviewed each search result set and filtered out articles not relevant to ERC topics. This left a range of 5 to 20 articles to post for the SME panel. Once articles were posted, each panel was contacted again and follow-up was done by email as well as through the website to ensure the SMEs were aware that articles were posted and in need of review. Thirty-two CPGs were assigned to nine panels using a total of nine SMEs recruited from the active duty pool of ERC experienced providers. Only eight CPGs reached a final analysis. In three cases, the final recommendation was for no edits. In five cases, there was a recommendation to edit the existing CPG to enhance care during the en route phase of care. Each of the panel-suggested edits was then formatted by the PI to maintain a consistent product to be forwarded to the JTS.

Voting was initially planned through the website, but this did not succeed. The only votes cast utilizing the website involved the PI and one other voting member. Functionality of the site was tested and remained intact. Further attempts to reach votes from the selected members (the Air Mobility Command Surgeon's En Route Care Advisory Committee) were done by email.

5.0 DISCUSSION

The goal of this project was to harness the power of many volunteer SMEs to review a large body of CPGs. No single base or command has had such a large collection of expertise in a single location. By centralizing the coordination and research labor, we hoped to maximize the SME capability into a new, more efficient method of CPG reviews. It was recognized early that as a fully volunteer force there would always be home station work, deployment, and life demands on each member and that these demands would impact the ability to dedicate time to the project. To counter this, the site and central research team were designed to minimize the efforts required by any volunteer. The goal was to maximize each member's expertise and minimize menial labor. To that end, all literature reviews were done centrally and further filtered by the PI to avoid overburdening panels with a large volume of irrelevant articles. SMEs were organized into panels initially based on backgrounds and location. This did not address the inherent long delays possible when a single member was unavailable due to prolonged deployment or other tasks. To better address this, the second and subsequent waves were assigned with a scheduling process in place from the start. Teams were assigned based on self-reported availability periods. Ultimately, this was ineffective in significantly improving responses as a team. In most cases, a panel once assigned exhibited little coordination. In many cases, no response could be reached or a single member took the task upon himself or herself. One SME completed 11 reviews.

Various methods were employed to improve the response from the volunteers. Before assigning teams for the additional CPGs, a positive affirmation was requested and non-responders were dropped from the pool. Emails and phone calls were used to communicate directly, as the chat room function of the website was not utilized by any team. Despite these adaptations, the study remained limited by the availability and responsiveness of the fully volunteer collection of SMEs.

The functionality of the website was brought into question by several teams during the initial assignments. Access to the site was blocked from some bases, requiring members to access it only from home and thus after hours spent on duty. Otherwise, the site seemed to function as intended, but few teams used it as intended. No team utilized the chat functions to discuss their assigned CPGs. Most every team that submitted a keyword search did so through

emails rather than the site itself. It did appear that the literature search result articles, posted in full text on the site for member download, were accessible to SMEs. This was the initial design and was considered highly effective, minimizing effort needed by any individual to review the literature.

6.0 CONCLUSIONS

This novel approach of using an all-volunteer pool of SMEs across the force to complete a guideline review proved difficult at best. In a more limited setting it might well be a useful method. Despite efforts to minimize the time required of each volunteer, the process remained too dependent on the responses from individual SMEs who have competing requirements from their assigned duties. With no requirement or incentive for completion, this task easily slipped down the priority list for the majority of the volunteers.

The process and website remain a valid way to centralize effort for future reviews. A trained researcher or librarian can be much more efficient at completing literature keyword searches. A central office, using the site as a communication and data transfer platform, can locate and distribute all of the relevant, full-text articles for any given topic. To leverage this process, the site has to be maintained and partnered with a paid librarian or dedicated research assistant.

7.0 CPG CHANGE RECOMMENDATIONS TO JTS

7.1 Blunt Abdominal Trauma, Splenectomy, and Post-Splenectomy Aeromedical Evacuation (AE) Considerations

AEROMEDICAL EVACUATION CONSIDERATIONS

In patients with splenectomy, the transporting team should ensure documentation of all vaccines given at the sending facility is sent with the patient.

In accordance with CPG ID 24 (Infection Prevention in Combat Related Injuries), antibiotic treatment duration for penetrating abdominal wounds will be 24 hours following definitive washout. Patients will be moved through the aeromedical system during that time and should have all appropriate dosing ensured during transport.

1. Preferred: Cefazolin 2 g IV q6-8 h PLUS metronidazole 500 mg IV q8-12 h[1]
2. Alternate: Ertapenem 1 g IV x 1 dose, OR moxifloxacin 400 mg IV x 1 dose

Abdominal trauma patients, regardless of temporary abdominal closure of any type, are at risk for compartment syndrome.

1. AE teams should make a risk assessment of each patient individually.
2. Moderate- or high-risk patients should have a baseline bladder pressure before transport and every 4 hours while in flight.

[1] IV = intravenous; q = every.

PERFORMANCE IMPROVEMENT MONITORING

PERFORMANCE/ADHERENCE MEASURES

- All patients will have vaccination documentation delivered with them to the receiving facility.
- Antibiotic dosing according to infection prevention guidelines will be documented during transport.
- Moderate- and high-risk patients will have bladder pressures recorded before and during transport.

7.2 Anesthesia AE Considerations

AEROMEDICAL EVACUATION CONSIDERATIONS

In patients who received massive transfusion or where otherwise indicated, consider obtaining coagulation labs (PT/INR, aPTT) and/or TEG/ROTEM (if available) immediately prior to aeromedical evacuation, as these laboratory values cannot currently be obtained in flight.[2]

PERFORMANCE IMPROVEMENT MONITORING

INTENT (EXPECTED OUTCOMES)

Patients undergoing massive transfusion will have coagulation studies drawn within 12 hours of critical care evacuation if lab facilities are available.

References:

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7.3 Aural Blast Injury and Acoustic Trauma AE Considerations

AEROMEDICAL EVACUATION CONSIDERATIONS

In patients with temporal bone fractures, any concomitant head injury will take precedence for AE considerations.

1. Patients should be transported with HOB elevated to 30-45deg or use reverse Trendelenburg position for concomitant spine/spinal cord injuries.[2]
2. Pneumocephalus will mandate an altitude restriction.

[2] aPTT = activated partial thromboplastin time; HOB = head of the bed; INR = international normalized ratio; PT = prothrombin time; ROTEM = rotational thromboelastometry; TEG = thromboelastography.

All patients moving though the en route care system will be exposed to high decibel environments. Particularly in unconscious patients, it is incumbent on the provider team to protect from further acoustic trauma.

3. All patients should have foam ear plugs placed prior to transport.
4. CSF leak is not a contraindication to foam plugs. These may be intermittently removed for placement of prescribed otic drops.[3]

PERFORMANCE IMPROVEMENT MONITORING

INTENT (EXPECTED OUTCOMES)

- All patients will have foam plug hearing protection provided during transport.
- Temporal bone fractures with Pneumocephalus will have altitude restrictions placed.

7.4 Orthopedic Trauma: Extremity Fractures AE Considerations

AEROMEDICAL EVACUATION CARE CONSIDERATIONS

Data suggest there may be improved outcomes with use of vacuum dressings for open fractures due to a decrease in deep infections. This is hypothesized to be through an advantage of converting an open environment into a closed environment. In the aeromedical environment, this benefit would likely be magnified given the inherently more exposed environment.

- Consideration should be given for placement of a vacuum dressing system on all open fracture wounds prior to aeromedical evacuation.
- Transport should not be delayed if such devices are not readily available.
- Wound vac systems have been approved for in-flight use.

7.5 Ventilator-Associated Pneumonia (VAP) AE Considerations

AEROMEDICAL EVACUATION CONSIDERATIONS

Patients receiving mechanical ventilation are at high risk for VAP especially during long transports back to CONUS.[3]

1. Topical selective decontamination of the digestive or respiratory tract (SDRD) using antibiotics should be considered for reducing the incidence of VAP.
2. Topical SDRD using antibiotics should be considered for reducing the incidence of all ICU-acquired infections.[3]

[3] CONUS = continental United States; CSF = cerebrospinal fluid; ICU = intensive care unit.

All mechanically ventilated patients moving through the en route care system, especially those who have had long stays at LRMC, are at risk for VAP.[4] Colonization of the aerodigestive tract is involved in ventilated-associated pathogenesis and is the main concern for implementing preventative/prophylactic treatment.

1. All mechanically ventilated patients should be considered to have the following prophylactic treatment for VAP:
    a. Oropharyngeal decontamination using topical antibiotics
    b. Gastrointestinal tract decontamination using topical antibiotics
    c. Oropharyngeal plus gastrointestinal tract decontamination using topical antibiotics
    d. Respiratory tract decontamination using topical antibiotics

PERFORMANCE IMPROVEMENT MONITORING

INTENT (EXPECTED OUTCOMES)

- All patients will be evaluated for use of topical SDRD.
- Decrease in the overall risk for VAP.

[4] LRMC = Landstuhl Regional Medical Center.

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LIST OF ABBREVIATIONS AND ACRONYMS

AE	aeromedical evacuation
CCATT	Critical Care Air Transport Team
CPG	clinical practice guideline
ERC	en route care
JTS	Joint Trauma System
PI	principal investigator
SDRD	selective decontamination of the digestive or respiratory tract
SME	subject matter expert
UC	University of Cincinnati
VAP	ventilator-associated pneumonia