



Electronic Trauma Resuscitation Documentation Using T6 Health Systems Mobile Application

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FINAL REPORT

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1.0 EXECUTIVE SUMMARY

Over the past two decades, combat casualty care has been poorly documented due to the impracticality of paper cards and forms in the tactical environment both in terms of being able to write on them as well as being able to secure them to ensure they make it to the next echelon of care. Currently, missing and/or inconsistent prehospital documentation may be contributing to inaccurate clinical practice guidelines. Action item #11 of the Department of Defense (DoD) Joint Requirements Oversight Council Memorandum (JROCM) dated 11 Dec 2017 directs the DHA and the Office of the Joint Staff Surgeon to “Enhance existing DoD trauma registry by leveraging existing IT structure in order to operate an adaptive, agile, and passive collection system to automate trauma information collection and sharing in the pre-hospital environment as well as the subsequent mapping of trauma injuries to clinicians, and providing clinical support tools in an operating environment” with a suspense 11 Dec 2019. In addition, Joint Force Health Protection (JFHP) initial capabilities document dated Feb 2010, Gap Joint Casualty Management (JCM) 1-10 identified "Inadequate integrated medical information systems across the taxonomy of casualty care." While the Joint Trauma System’s (JTS) Performance Improvement (PI) initiative is to improve trauma system performance including recommendations for patient evaluation and treatment across the DoD care continuum, the next iteration of Electronic Health Record (EHR) management, Military Health System (MHS) Genesis, does not offer trauma resuscitation recording templates that meet the needs of trauma care providers, and there are no plans currently to transition to using MHS Genesis to electronically document trauma resuscitations in real-time. It is also important to note that MHS Genesis does not currently support the data collection (data fields contained in DD3019) and reporting requirements of the DoD trauma patient registry program. The existing process and current MHS Genesis expectations do not reflect the Agency’s quadruple aim for joint trauma care; a better solution is needed to support the care of trauma patients and enhance the operational efficiency and effectiveness of the MHS. There is an urgent unmet operational need for an information technology (IT) solution that will enable medics to better capture patient treatment information to improve long term healthcare without impacting short term care responsibilities. Currently, medics and providers have limited capabilities to document combat casualty care in austere environments including initial resuscitation of trauma patients from point-of-injury (POI) prehospital environments to surgical teams at role of care II and III.

The T6 Health System mobile device application is a high resolution, digital documentation system, that is a multi-dimensional data and point-of-care analytics system that opens up the possibility of precision and predictive trauma care to theater if we are able to explore the feasibility of using this technology in routine care of trauma patients, mass casualty situations, point of injury and enroute care. This electronic application will capture the same data as the current written record in a more accurate way, in a searchable document, and exportable/ up loadable format. This software application mirrors the current JTS documentation in an electronic format (Figure 3) that can be conducted on a hand-held device, assist with data visualization and real time tracking, provide decision support tools during patient care, evaluate for clinical practice guideline compliance, provide coding and grading of injuries and patient scoring that is relevant to the national trauma registry data input as well as the DoD Trauma Registry (DoDTR), and export this record in a searchable PDF document that can be automatically programmed to upload to the patient EHR. It will also export batches of patient data into a format that can be transferred to a trauma registry which is currently populated

manually by personnel reading handwritten records and inputting the individual data fields in the registry.

T6 measures and reveals adherence to processes and procedures established by evidence-based medicine. Fast-paced, decisive, and resource-intensive disciplines are ideal for systemic application of “best practice” guidelines and checklists to improve patient outcomes and reduce the total cost of care. Fueled by fresh point-of-care data, T6 measures variation between clinical activities encouraged by guidelines versus activities actually performed, to reveal variability in frontline practice. Viewable by individual guidelines, patient encounters, dates and various other filters, these visualizations bring a new level of efficiency and focus to Performance Improvement and Patient Safety (PIPS) meetings by spotlighting cases that warrant further review and the specific clinical processes and circumstances that led to any adverse events.

T6 automates time-driven, activity-based costing to provide a full picture of all cost contributors, economic trends and cost improvement opportunities. T6 considers healthcare costs across four domains: personnel, equipment, supplies, and space. The system breaks down and maps every patient’s diagnostic and therapeutic activity into discrete steps and minute-level time intervals, and links each of these clinical steps in the process to actual costs across each of the four domains. The result is a framework and a fully automated, time-driven, activity based costing process for spotlighting and eliminating waste and aligning reimbursement with the true cost of delivering care. As of now, this information is not well documented, thereby limiting the DoDs ability to properly plan for supplies, equipment, and personnel needs.

We believe that mobile applications with high resolution, digital documentation systems, that are multi-dimensional data and point-of-care analytics systems open up the possibility of precision and predictive trauma care to theater. These mobile technologies will be designed to have the following features: provide a highly accurate, time-stamped record of all resuscitation activity; no time delays and real time data sharing within the applications; searchable and exportable/uploadable data format for information sharing; real-time tracking of all products, supplies and equipment used during patient care for inventory and supply chain management; clinical process surveillance for supporting continuous process improvement goals leading to a high reliability clinical outcome; reduction of transcription errors with real-time data entry and capture, increasing patient safety, one of the highest goals of the MHS; reduction of duplication of effort, and redundancies thus allowing optimal time with patients; reduction in manpower requirement for trauma care documentation as team members can seamlessly enter data in real-time; system monitoring and reporting provider and system effectiveness, and mirroring clinical processes to support point of care (POC) decision-making and longitudinal medical record generation; just-in-time clinical practice guidelines (CPG), checklists, and offering predictive and prognostic scores for the team leader. This project involves research across the spectrum of care from POI through enroute, and at military treatment facilities (MTF).

2.0 INTRODUCTION

Currently, trauma resuscitation events are recorded and documented on a handwritten 4-page form in real time in the ED. The current format is a handwritten real-time record that is later scanned and uploaded in EHR to become part of the patient record. The current handwritten documents require someone to scan them into a file and then another person at a later time to

access that file to upload these documents to the EHR. This often times results in lost records or delayed availability. The scanned documents are also not searchable or downloadable into a dataset format.

The current trauma resuscitation documentation and data collection process in-theater is very similar to the process in-garrison. A 5-page paper form (trauma resuscitation record) is utilized to document patient care and is hand-written by healthcare teams. The Joint Trauma System's DoD Trauma Registry struggles with data capture since much of it relies on handwritten documents and from memory during trauma events that must be scanned to be trackable/viewable by registry personnel. Unfortunately, there are many flaws in today's healthcare environment with a pen and paper system of documentation; much of the paper documentation comes up missing, is not legible, and in theater, many pieces of the patients record remains behind in theater, never making it to the central data repository (CDR) due to the nature of traumatic events under duress in a war zone. The T6 Health System mobile device application is a high resolution, digital documentation system, that is a multi-dimensional data and point-of-care analytics system that opens up the possibility of precision and predictive trauma care to theater if we are able to explore the feasibility of using this technology in routine care of trauma patients, mass casualty situations, point of injury and enroute care. The in-theater trial will allow us to conduct a simulation of utilizing the application through the continuum of care involving all potential end-users and stakeholders to determine logistical and technical feasibility. Utilization of such an electronic record capture tool will enable us to realize the benefits over a paper and pen system that has many times failed the healthcare delivery system in capturing longitudinal health record information for our warriors and all beneficiaries under our care. The application promotes and supports a reliable and secure bi-directional data exchange with existing information systems. (Figures 1 & 2)

We sought to explore the option of an electronic resuscitation record for more efficient and effective patient care and data capture for outcomes evaluation. This electronic application will capture the same data as the current written record in a more accurate way, in a searchable document, and exportable/ up loadable format. The current format is a handwritten real-time record that is later manually scanned and uploaded into the EHR to become part of the patient record. This software application mirrors that process in an electronic format that can be conducted on a hand-held device, assist with data visualization and real time tracking, provide decision support tools during patient care, evaluate for clinical practice guideline compliance, provide coding and grading of injuries and patient scoring that is relevant to the national trauma registry data input as well as the DoD Trauma Registry (DoDTR), and export this record in a searchable PDF document that can be automatically programmed to upload to the patient EHR. It will also export batches of patient data into a format that can be transferred to a trauma registry which is currently populated manually by personnel reading handwritten records and inputting the individual data fields in the registry.

3.0 METHODS, ASSUMPTIONS AND PROCEDURES

Experimental Design and General Procedures: We conducted two pilot projects. Phase I was conducted at Brooke Army Medical Center (BAMC) in which we performed analysis on effectiveness of training, completeness of records, and accuracy of records as a potential replacement for the paper documentation. This was accomplished by performing parallel documentation and conducting a head-to-head comparison of the two processes. Phase II was performed at a Role III in Afghanistan. There we set up a similar pilot but expanded it to include Medevac use and a tabletop exercise to assess the operational limitations of the application as a solution for the continuum of care and develop mitigating plans and configuration changes to see if the application can meet the needs of the DoD.

Hypothesis/Objectives: Field trauma resuscitation electronic documentation application for feasibility and improved patient data collection, tracking and trending, and transfer. We will use this information to make recommendations to AMC, ACC, CENTCOM, and DHA.

Study Design: The goal fielding the T6 Health System's technology within the DoD patient care continuum is to increase efficiency and effectiveness of patient care through digital documentation, as well as to capture high resolution data for outcomes and clinical process surveillance and evaluation. This mobile platform will capture much more than the data we currently capture in a handwritten record, and it will offer several key advantages:

1. Highly accurate, time-stamped record of all resuscitation activity (far higher data fidelity than paper records)
2. No time delays (real time data sharing within the application)
3. Searchable and exportable/up-loadable data format for information sharing
4. Real-time tracking of all products, supplies and equipment used during patient care for inventory and supply chain management; maximizes financial performance through accurate cost accounting and charge capture
5. Clinical process surveillance for supporting continuous process improvement goals leading to a High Reliability clinical outcome
6. Reduction of transcription errors with real-time data entry and capture, increasing patient safety, one of the highest goals of the MHS and AFMS; brings complete, high-quality evidence and fundamental insights to health policy and management
7. Enables the healthcare team to focus 1:1 with the patient instead of fumbling around for pen and paper documentation, thus distracting the healthcare team's attention from the patient
8. Reduces duplication of effort, redundancies and allows optimal time with patients; reduction in manpower requirement for trauma care documentation as team members can seamlessly enter data in real-time, and appoint a single team member for data entry to enable the remaining team members to focus on the patient
9. To improve trauma care, the quality of care first needs to be measured using evidence-based tools as the T6 Health System application provides; the system monitors and reports provider and system effectiveness, and mirrors clinical processes to support point of care decision-making and longitudinal medical record generation.

10. T6 also provides just-in-time clinical practice guidelines, checklists, and offers predictive and prognostic scores for the team leader.

For Phase I, we used the electronic application to perform the same documentation in parallel to the current practice in garrison at the DoD's only Level I Trauma Center (BAMC). We then performed a comparative analysis of completeness, accuracy, and impact of the electronic documentation as compared to the handwritten form as a process improvement project as well as quality improvement. We sought to determine if the process of electronic documentation is better than the handwritten process. We also assessed if the electronic documentation is higher quality than the handwritten documentation. We did this by conducting concurrent collection of data over a 5-month period. Head-to-head comparison of electronic documentation versus handwritten documentation to include time accuracy, data completeness, usability, faster access, success of record capture, and more efficient registry data point capture. Trauma patient resuscitation data points was collected as standard of care on both the current handwritten form and using the electronic application. Data included pre-hospital, triage, resuscitation, primary, secondary and tertiary patient survey, diagnostic and therapeutic interventions, etc.

In Phase II, conducted similar pilot in the deployed environment (Role III, Craig Joint Theater Hospital, Bagram Airfield, Afghanistan). We conducted a table-top exercise to bring other end users to assess the use of the application throughout the continuum of combat casualty care (POI, Dust-off, AE, Role II, CCATT, etc.) to assess the feasibility/ usability of application across the theater continuum of care. Finally, we configured, set up, and trained personnel at the deployed location. We conducted a similar analysis as that described above in collaboration with the JTS and DoDTR representatives. We also incorporated the synchronization function by utilizing the application in the prehospital environment (Medevac).

Data Analysis:

Completeness and accuracy of the electronic records was calculated using the paper records as the standard. Data was broken into the following sections based on the structure of the trauma record: admit, prehospital, primary survey, secondary survey, interventions, and trends data. The records were summarized using means and standard deviations for each category. A one sample 2-sided Wilcoxon's rank sum test was used to compare Completeness to 100%. Significance was established when the p-value was less than 0.05. All analyses were performed using JMP v13.2 (SAS Corp, Cary NC).

4.0 MAJOR EVENTS/MILESTONES/SUCCESS

In preparation for the execution of this project:

- Project Kick Off Meeting – June 2018
- Develop Protocol – June 2018
- Obtain IRB approval (NRD) – 07/2018
- Execution of protocol – 06/2019
- Data Analysis and Interpretation – 01/2020

- Development of final report/manuscript – Journal of Trauma and Acute Care Surgery published Dec 2020: 02/2021

5.0 RISK ASSESSMENT

5.1 Risk Analysis:

FY20Q1 - NA

FY20Q2 -

The COVID telework situation impacted the completion of the technical report from AFMRA. We continued to collaborate with the technical team. We are only slightly delayed in our major manuscript submission. It is undergoing revisions now in preparation for journal submission.

FY20Q3 -

The COVID telework situation impacted the completion of the technical report from AFMRA. The test plan has been developed. We continue to collaborate with the technical team. Our final manuscript has been submitted and is under review by journal after initial round of revisions.

FY20Q4-

The COVID telework situation impacted the completion of the technical report from AFMRA. The test plan has been developed. We continue to collaborate with the technical team. Our final manuscript was accepted for publication.

FY21Q1-

The COVID telework situation impacted the completion of the technical report from AFMRA. The test plan has been developed. We continue to collaborate with the technical team. Our final manuscript has been published in Journal of Trauma and Acute Care Surgery Dec 2020.

5.2 Technical Challenges

FY20Q1 - NA

FY20Q2 -

The COVID telework impacted the completion of the technical report from AFMRA but had minimal impact on journal submission of our primary manuscript. Estimated delay until submission is 30 days. We continued to communicate with the AFMRA technical team a couple of times per week to keep momentum for the work towards the technical evaluation and report for the application.

FY20Q3 -

The COVID telework impacted the completion of the technical report from AFMRA but had no impact on journal submission of our primary manuscript. We continued to communicate with the AFMRA technical team a couple of times per week to keep momentum for the work towards the technical evaluation and report for the application.

FY20Q4-

The COVID telework impacted the completion of the technical report from AFMRA but had no impact on journal publication of our primary manuscript. We continue to communicate

with the AFMRA technical team a couple of times per week to keep momentum for the work towards the technical evaluation and report for the application.

FY21Q1-

The COVID telework impacted the completion of the technical report from AFMRA but had no impact on journal publication of our primary manuscript. We continue to communicate with the AFMRA technical team a couple of times per week to keep momentum for the work towards the technical evaluation and report for the application. Closure report in draft.

6.0 TRANSITION PLAN

6.1 Military Relevance

The vision is that this digital technology may benefit deployed medicine by providing a more accurate, easier to use and more efficient documentation process, in addition to the many benefits afforded by point of care digital data capture and real time data processing. In addition, it is our opinion that fielding this technology in the deployed environment will help mitigate some patient care gaps. We plan to implement T6 as a stand-alone system within the trauma bays and design a tabletop exercise with all end-users and subject matter experts to weigh in on logistics, technology, and configuration for the continuum of care. These participants should include battlefield medics, aeromedical evacuation teams, Role II trauma team members, critical care air transport team members, DoD Trauma Registry representatives, and Theater Medical Data Store. Research has shown that to improve trauma care, the quality of care first needs to be measured using evidence-based tools as the T6 Health System application provides.

T6's user interface logically parallels our standard trauma resuscitation process to streamline documentation on a handheld device. The software analyzes accruing data and visualizes information in real time to improve team dynamics, support critical decision making, patient risk prediction and evaluation of compliance with our clinical practice guidelines. The software also records injury grading and coding, including for the purposes of national trauma registry data input. And lastly, T6 has the ability to export the high-fidelity record in a searchable PDF document that can be uploaded into our EHR as well as for exporting all the collected data to our registry.

6.2 Transition Strategy

Results from this project will be provided to JBSA leadership, as well as decision makers from DHA and JTS. Abstracts were submitted for poster/podium presentations at national conferences such as the Eastern Association for the Surgery of Trauma and the Military Health System Research Symposium. Manuscript was submitted for publication to Journal of Trauma and Acute Care Surgery, Military Medicine. Readiness level of 8 assessing if the application works in the context of interest and knowledge product level 3 community.

The success of the pilot resulted in efforts to transition to an information management/information technology (IM/IT) program management office (JOMIS or possibly Solutions Delivery Division [SDD] under DHA J6) to manage the deployment with the JTS as the primary customer/consultant community. The assigned IM/IT program management office will develop operator guidance, resolve operating issues, establish an Authority to Operate (ATO),

develop Application Program Interface (API) capability associated with current Cerner or MHS GENESIS EHR for insertion into the patient record, develop user training, and plan for system sustainment.

Proposed Implementation Strategy

Software and Configuration Engineering Costs

T6 Health Systems' software products and engineering services are sold separately from any third-party support services. Software is charged as an annual license. A standard annual 2% escalation is applied.

Suggested Year 1 pricing:

T6 Annual Enterprise/Unlimited Software License for use in Garrison and Theatre MTF Emergency Departments:

- \$2,500,000/year (based on T6's SaaS model pricing applied to annual volume of 7000 episodes of trauma care for in-garrison and theatre facilities)
- The above annual cost includes 2,000 engineering hours for configuration and development. Rate for additional engineering time is \$150.00 per hour
- The above annual cost includes 200 training hours supporting the train-the-trainer model. Rate for additional training time is \$125.00 per hour

In the event that the annual software use exceeds 8500 patient episodes, T6 reserves the right to renegotiate the costs outlined above. Additional T6 Health Systems' products and services, such as software for the care of non-trauma patients, or the care of trauma patients in environments other than emergency departments in garrison and theatre, are outside this scope.

Any additional service and product requests, such as Risk Management Framework (RMF), is to be paid for by the government as time and material. This estimated cost RMF is \$700,000, and the estimated timeframe is 6-9 months.

Hardware Costs

Hardware requirements scale based on the number of trauma resuscitation bays per location. An estimated list of hardware necessary for a treatment facility is as follows. Items must be purchased separately by the government.

- Hardware estimate for outfitting a large emergency department consisting of 8 trauma resuscitation bays (BAMC or similar) is: \$80,000.

- o16 HD monitors with mounts

- o16 Apple TVs

- o8 iPad stands

- o16 iPads

- o2 servers

- o2 printers

- o2 WIFI routers

- o1 UPS

- oCables and software

- Hardware estimate for outfitting a medium-size treatment facility consisting of 6 trauma resuscitation bays (Role III at Bagram Airfield or similar) is: \$65,000.

- o12 HD monitors with mounts

- o12 Apple TVs

- o6 iPad stands

- o12 iPads

- o2 servers

- o2 printers

- o2 WIFI routers

- o1 UPS

- oCables and software

- Hardware estimate for outfitting a small treatment facility consisting of 1 trauma resuscitation bay is: \$7,000.

- o2 Apple iPads

- o1 server

- Samsung devices such as, but not limited to, Galaxy S8, S9, S10, S20, Tab A's, and iPads

Train-the-trainer Plan

In a phased approach, super users, expert and less experienced trauma team members will move from online videos to hands-on training with the user interfaces of each application, to multi-disciplinary and multi-stage simulation, and finally to being shadow supported during real clinical situations.

Mobile platform organization will develop a train-the-trainer model to educate and support the identified superusers on all the nuances of using the technology to improve trauma team performance and collect and share high resolution data. Once trained, these superusers will continue to educate new clinicians in-garrison and theatre locations.

Phase 1: online training

Time required: approximately 3 hours

Phase 2: in-person team training

Time required: approximately 5 hours

Superusers/trainers deliver group and individual user training in classroom and simulation-based environments and remain on site for 1 week to provide real resuscitation shadow support (based on individual MTF's patient volume).

Based on a working number of 37 MTFs for, a 1 week per location schedule will require a 12-month system-wide deployment schedule.

Deployment Timeline

Phase 1, Base Year

Risk Management Framework (RMF) and Development & Integration

Major tasks for Phase 1 would include a heavy focus on Risk Management Framework

(RMF), requirements collection/development, Standard Operating Procedures (SOPs) development, initial data development/integration with JTS and AHLTA-T. Major milestones would include 100% training of superusers identified by the government (train-the-trainer model).

Phase 2, Year 1

Initial JTS and AHLTA-T Roll-Out and Critical Care Air Transport Teams (CCATT) Development & Integration

Major milestones for Phase 2, year 1 would include 100% deployment to Role III MTF trauma resuscitation bays. Major tasks include CCATT requirement collection/development.

Phase 3, Year 2

CCATT Roll-Out and Aeromedical Evacuation (AE) & Medical Evacuation (MEDEVAC) Development & Integration

Major milestones for Phase 3, year 2 would include 100% deployment to MTFs with CCATT capabilities. Major tasks include AE and MEDEVAC requirement collection/development.

Phase 4, Year 3

AE & MEDEVAC Roll-Out and DHA (Genesis) Development

Major milestones for Phase 4, year 3 would include 100% deployment to MTFs with MEDEVAC and AE capabilities. Major tasks include development to send data to and integrate with information systems such as Genesis.

Phase 5, Year 4

Genesis Integration & Application Modernization/Enhancements

Major milestones for Phase 5, year 4 would include data sharing/integration with Genesis for all MTFs using the technology.

7.0 RESULTS

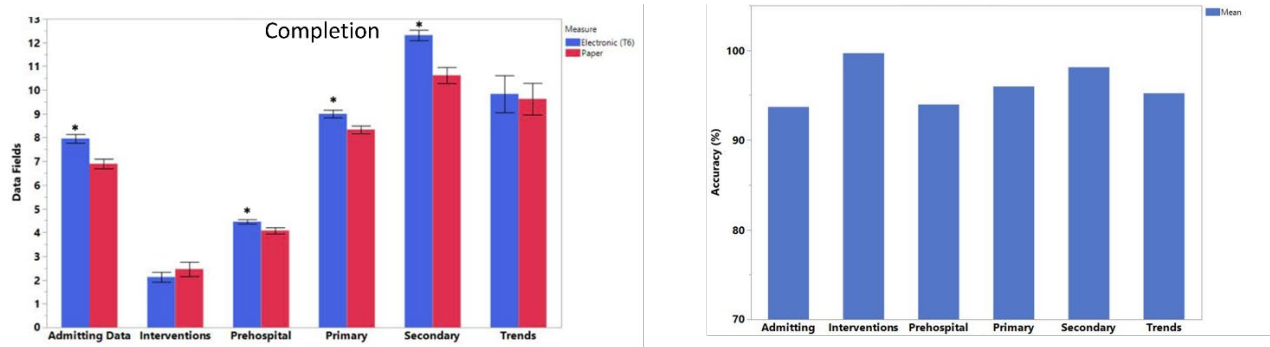
The BAMC Pilot was conducted from Oct 2018 – Feb 2019. (Figures 3, 4) We reviewed 61 electronic charts compared to paper records. We found that 10% of paper records missing from EHR, several written records were not available to the trauma team for >3 weeks in HER, no records were lost by T6, and all data collected were available immediately in digital format. Overall (excluding trends) completion rate was 94.9% and accuracy was 90.4% for the electronic application. (Figures 5, 6)

The initial part of Phase II at the deployed Role III hospital involved a Table Top exercise that included providers from all roles of care (POI, Medevac, CCATT, Role II/III). (Figures 7-9) This event revealed areas of potential integration of POI devices and applications, configuration modifications to accommodate the combat environment, and technological aspects that require mitigation for the application to function in the deployed environment. (Table 1) This exercise helped define the requirements of a mobile application that can consolidate continuum of combat casualty care of patients into one record.

Finally, we conducted the 90-day deployed Role III pilot during which time there were 131 trauma evaluations of which 53 patient resuscitations (40.5%) were also documented in the electronic application. Using those 53 records, we found an overall 13% increase in data capture

at 96% accuracy compared to the written record. Accuracy of electronic documentation compared with paper by section of the record was: Admitting Data 93.7%, Interventions 99.7%, Prehospital 94.0%, Primary 96.0%, Secondary 98.1%, and Trends 95.2% which demonstrates non-inferiority of the electronic record with all sections being >95% accurate. Completion of electronic documentation compared with paper by section of the record was: Admitting Data 119.7% (p<0.0001), Interventions 94.2% (p=0.9826), Prehospital 116.2% (p=0.0039), Primary 109.6% (p<0.001), Secondary 125.5% (p<0.001), and Trends 114.8% (p=0.0720). The percent completion was significantly greater than 100% in the Admitting Data, Prehospital, Primary, and Secondary sections (Figure 10, 11).

We also had the medical evacuation teams document prehospital and enroute care, and then synchronize the record in the trauma bay (Figure 2). This allowed the trauma teams to continue documenting on the same patient record, likely contributing to superiority since teams did not have to re-document based on an oral report. Figure 3 shows use of the mobile application during a trauma resuscitation. For interventions section of tool, higher data field capture rates were superior to the written records. (Figure 12,13)



8.0 CONCLUSION/DISCUSSION

Over 5 months of the BAMC pilot, including training and implementation, we observed stable high data field capture rates for each section of the tool; admitting data, prehospital data, primary survey, secondary survey, and interventions. The accuracy of data captured remained high throughout 5 months of training and implementation. There was a significant decrease in usage over last 2 months. However, completeness and accuracy remained high even as use dropped off.

Our pilot program in the deployed environment demonstrated a mobile technology that actually enhanced the completeness and accuracy of trauma documentation. Previous retrospective studies in civilian trauma centers have demonstrated improved data capture using electronic documentation systems, but ours is the first prospective study performing a head-to-head comparison of documentation during the same resuscitation. Our study is also the first to describe the use of electronic trauma documentation in the deployed setting. The ability to document electronically removes the issues of illegible handwriting and lost documentation. Electronic synchronization of prehospital and enroute documentation also likely decreases errors by eliminating the need to rapidly transcribe the medics' oral report. Finally, we demonstrated that in the current technological era, an electronic application can be readily learned and applied

accurately in practice, even in a hectic trauma resuscitation, with improved data capture compared to the established paper documentation. This ultimately allows for more efficient data and care analysis, decision support, process improvement, resource utilization, clinical practice guideline compliance, and appropriate automated data integration into a trauma registry.

The application can alert providers to practice guidelines based on data points being captured real time. This should help improve guideline compliance, especially in a deployed environment with more frequent staff turnover and variable trauma experience. The application also has the ability to instantly upload the files upon completion in various formats, both to the patient chart and to the trauma registry. This allows rapid access in a searchable format for future quality research and process improvement efforts which is paramount in trauma and combat casualty care.

Our initial pilot studies had several limitations. Due to the need for additional staffing to perform the double documentation, which was not always available, our sample size was limited. We also calculated our accuracy as compared to the paper documentation, which was considered the standard for the purposes of our study. However, the paper documentation may not necessarily always be accurate, limiting our analysis of the accuracy of the electronic data entry.

The next step in implementation of the T6 Health Systems Mobile Application as the primary method of trauma documentation in the in-garrison and deployed setting is an on-network deployment to ensure reliable communication between the application, the patient monitors to allow vital sign capture in real time, and the patient medical record. This will allow additional study of data completeness and accuracy with a larger sample size. Future study could also examine accuracy of prehospital and enroute care documentation by synchronizing with the application versus transcribing an oral report, as well as the ability to improve compliance with clinical practice guidelines using the decision support features of the application.

9.0 DELIVERABLES

9.1 Publications:

1. Angotti LM, How RA, Barnack KR, Aden JK, Vitale DA, Folwell JS, Neel JM, Srivilasa CN, Sams VG. Electronic trauma resuscitation documentation and decision support using T6 Health Systems Mobile Application: A combat trauma center pilot program. *J Trauma Acute Care Surg.* 2020 Dec;89(6):1172-1176.

9.2 Presentations:

1. Angotti L, How R, Vitale D, Folwell J, Sams V. Electronic Trauma Resuscitation Documentation and Decision Support Using T6 Health Systems Web-Based Application: A Pilot Program. SAMMC Patient Safety Week, Mar 2019; SURF, San Antonio June 2019.
2. Angotti L, How R, Vitale D, Folwell J, Sams V. Deployed Exercise Using T6 Health Systems Web-based Application Electronic Trauma Resuscitation Documentation and Decision Support. Poster Presentation MHSRS Aug 2019.
3. Sams V, Angotti L, How R, Vitale D, Folwell J, How R. Electronic Trauma Resuscitation Documentation and Decision Support Using T6 Health Systems Web-Based Application:

A Pilot Program. Podium Presentation, MHSRS Aug 2019.

4. Angotti L, How R, Vitale D, Folwell J, Barnack K, Neel J, Srivilasa C, Sams V. Electronic Trauma Resuscitation Documentation and Decision Support Using T6 Health Systems Mobile Application: A Combat Trauma Center Pilot Program. Quick Shot Podium presentation, EAST Jan 2020.

10.0 COST

This work was funded by the 59th MDW, FY18 711HPW-6.3-633080-AC \$204K Authorized 29 MAR 2019.

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6. Angotti L, How R, Vitale D, Folwell J, Barnack K, Neel J, Srivilasa C, Sams V. Electronic Trauma Resuscitation Documentation and Decision Support Using T6 Health Systems Mobile Application: A Combat Trauma Center Pilot Program. *J Trauma Acute Care Surg.* 2020
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FIGURES AND TABLES:

Figure 1: 5 Page Trauma Resuscitation Flow Sheet and T6 Application on an iPad



Figure 2: T6 Mirror of Application on Apple TV in Trauma Resuscitation Bay

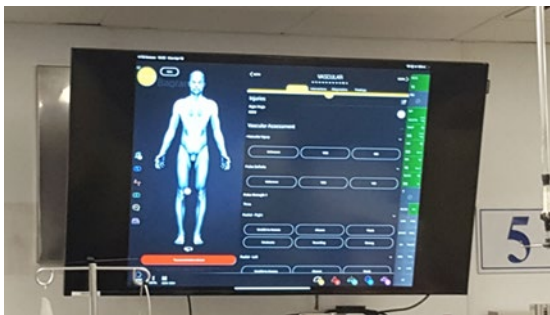


Figure 3: In-Garrison Trauma RN Scribe in Resuscitation Bay

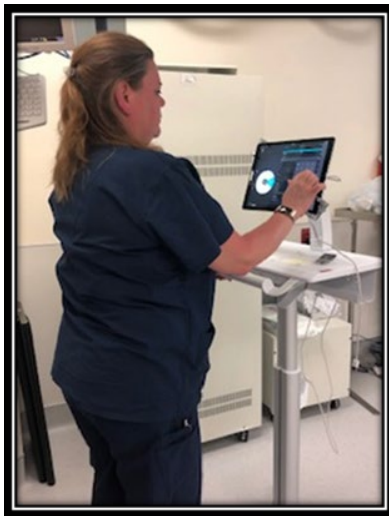


Figure 4: In-Garrison Trauma RN Scribes Continuing Documentation at CT Scanner

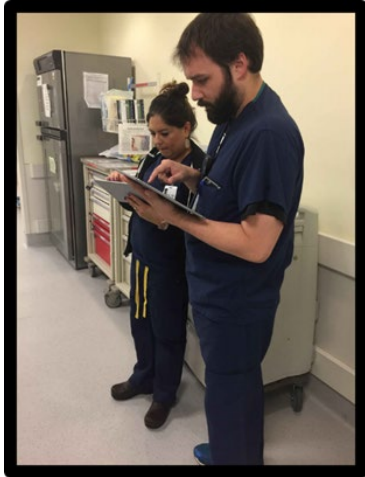


Figure 5: In-Garrison Completion and Accuracy by Data Section

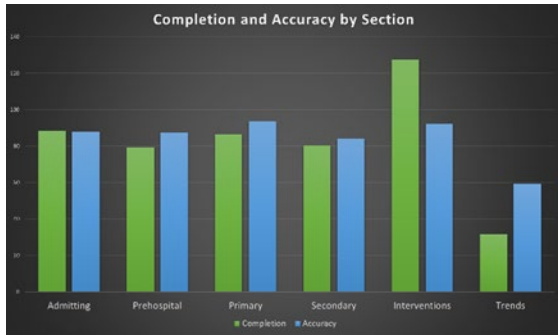


Figure 6: In-Garrison Completion and Accuracy by Month

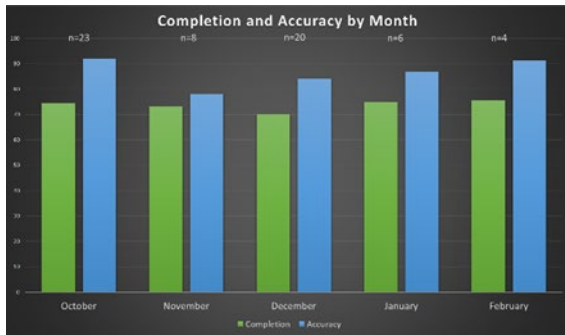


Figure 7: Table Top Exercise at Deployed Role III Hospital



Figure 8: Participants by Deployed Role of Care

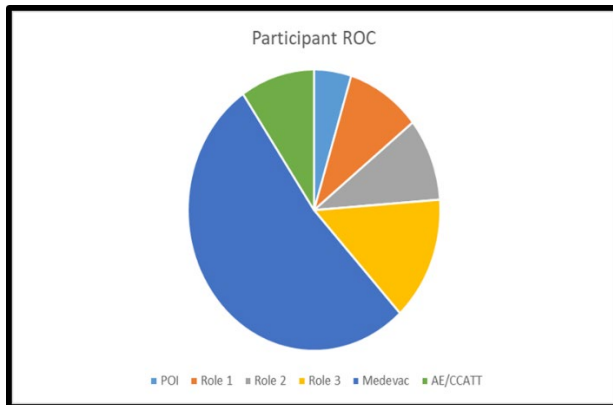


Figure 9: Participant by Type of Provider in Deployed Setting

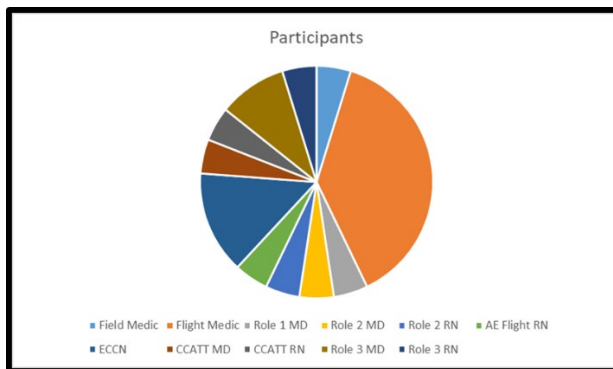


Table 1: Deployed Role III Tabletop Exercise Participant Input

Participant	Key Point
Medic (POI/Medevac)	Current operational environment and capabilities
Medic (POI)	Connectivity/pt hand-off ("WiFi-like", bluetooth, plug/download, secure WiFi)
Medic (POI/Medevac)	Need to incorporate application into formal training courses
Medevac/AE/CCATT	Audio recording would be useful
Medevac/AE	Ability to scan documents and take photos important
Medic (POI)	Need to be easy to use by non-medical POI prsnl entering information
Medic	TCCC & MIST at POI should use smaller device (iPad mini/ iPhone)
AE	Minimal documentation, have iPads, if synchronizes with EHR then useful
CCATT	All handwritten, difficult to track/maintain; ability to document MIST, VS, Tx
All	Sections based on skill level; not all alerts needed for each; medic/RN/MD
All	Protocols and algorithms ties to roles of care (configuration)
RN/MD	Info forward populate, ability to sign off each section, defined editing capes
Medics, Role I	Integration of PFC guidelines after set time
Medevac/ AE/ CCATT	Integration of various monitors to feed info (vital signs) into application

Figure 10: Medevac RN Synchronization with Trauma RN Scribe at deployed Role III

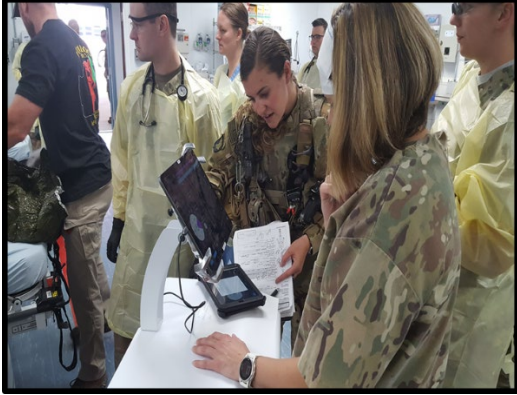


Figure 11: Deployed Role III Trauma RN Scribe Continuing to Document after Synchronization

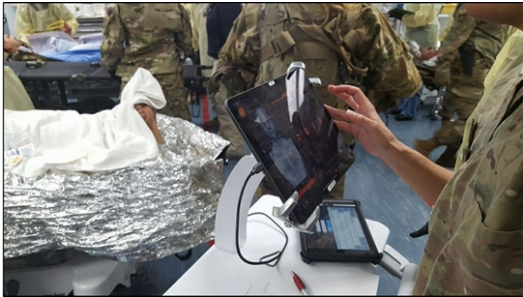


Figure 12: Deployed Role III Completion by Data Section

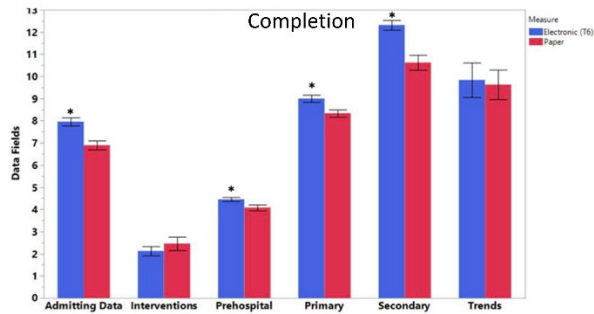
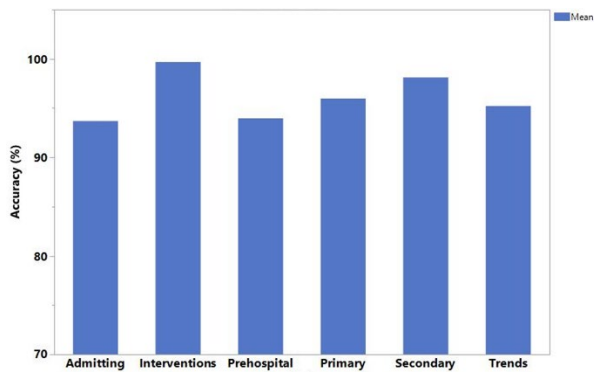


Figure 13: Deployed Role III Accuracy by Data Section



12.0 LIST OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

Aeromedical Evacuation (AE)
Air Combat Command (ACC)
Air Force Medical Service (AFMS)
Air Mobility Command (AMC)
Application Program Interface (API)
Armed Forces Health Longitudinal Technology Application – Theater (AHLTA-T)
Authority to Operate (ATO)
Battlefield Assisted Trauma Distributed Observation Kit (BATDOK)
Brooke Army Medical Center (BAMC)
Central Command (CENTCOM)
Clinical Data Repository (CDR)
Clinical Practice Guideline (CPG)
Critical Care Air Transport Team (CCATT)
Defense Health Agency (DHA)
Department of Defense (DOD)
Department of Defense Trauma Registry (DODTR)
Electronic Health Record (EHR)
Emergency Department (ED)
Information Management (IM)
Information Technology (IT)
Joint Casualty Management (JCM)
Joint Base San Antonio (JBSA)
Joint Force Health Protection (JFHP)
Joint Operational Medicine Information Systems (JOMIS)
Joint Requirements Oversight Council Memorandum (JROCM)
Joint Trauma System's (JTS)
Military Health System (MHS)
Military Treatment Facility (MTF)
Performance Improvement (PI)
Performance Improvement and Patient Safety (PIPS)
Point of Care (POC)
Point of Injury (POI)
Risk Management Framework (RMF)
Standard Operating Procedures (SOP)
Solutions Delivery Division (SDD)