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FOXTROT Mobile Eye Care App

Jennifer Stowe

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14. ABSTRACT
Introduction: During Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), 10-15% of combat-related trauma injuries involved the eye. During Operation Resolute Support (ORS) and Operation Freedom's Sentinel (OFS), 7% of patients presenting to the emergency department required ophthalmic surgical intervention, and 13% of trauma patients requiring surgical intervention underwent an ophthalmic surgical procedure. The military ophthalmologist's primary mission is to be prepared to manage ocular trauma, especially in an austere environment. However, with operations across the globe, military personnel are deployed across great distances often in remote locations with limited communication capabilities and no access to ophthalmic care. The primary purpose of our research was to develop an operationally secure, Health Insurance Portability and Accountability Act (HIPAA) compliant, mobile application (mApp) to provide ophthalmic care to any remote deployed location through teleophthalmology called Forward Operating Base Expert Telemedicine Resource Utilizing Mobile Application for Trauma (FOXTROT).

15. SUBJECT TERMS
Teleophthalmology, telemedicine, ophthalmology, emergency care, military telemedicine

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14. Abstract (continued)

Despite the high incidence of combat ocular trauma and ophthalmic disease non-battle injury within the operational environment, presently, there are limited options for teleophthalmology at forward operating bases. Combat operations, limited tactical communication capabilities, restricted wireless local area networking, and the remote geography of many operations make teleophthalmology challenging. In ocular emergencies or time-sensitive cases, first responders at Role 1 or 2 call and speak directly with physicians at Role 3. Typically, the ophthalmologist is reached by calling the hospital tactical operations center at Role 3. The ophthalmologist is then paged or called and can speak with the first responders to provide a consultation. If a wireless network is available at Role 1 or Role 2, it may be possible to send text messages, pictures, or videos. However, sending patient information using non-approved applications may violate the Healthcare Insurance Portability and Accountability Act (HIPAA), parity laws, tort law, rules of informed consent, and the need for operational security of the mission. In less time-sensitive cases, the web-based teleconsultation systems developed by the Navy called Health Experts Online Portal (HELP) or Pacific Asynchronous Telehealth (PATH) are available. The PATH and HELP systems allow users to ask consult questions and upload images. The Army Ocular Teleconsultation program has been retired and not replaced by another e-mail solution. A mobile phone application has advantages in convenience, ease of use, user satisfaction, and response time over other asynchronous telemedicine options such as a web-based portal like PATH or HELP.

Methods: Our team, working with Telemedicine & Advanced Technology Research Center (TATRC), developed the FOXTROT mobile application using the Mobile Health Care Environment – Research (MHCE-R) system. FOXTROT was beta-tested in Afghanistan and at one expeditionary medical group outside of Afghanistan in the Middle East over six weeks between September and November 2019. Beta testing was approved as a PI project by the United States Central Command (CENTCOM) Command Surgeon and reviewed by the U.S. Army Medical Research and Development Command's Office of Research Protections Institutional Review Board (IRB) Office and given a Determination of Not Research. To our knowledge, FOXTROT was the first approved, secure, HIPAA compliant mobile phone application utilized for teleophthalmology by the U.S. military in a combat zone.

Results: There were 30 users at 16 locations in Afghanistan and 1 location outside of Afghanistan that were participants. There were 11 users at Role 1, 6 at Role 2, and 13 at Role 3. There were 29 consults placed over 6 weeks by 18 of the 30 users. One consult did not sync due to connectivity problems, resulting in 28 consults received by the expeditionary ophthalmologist in theater.

Previous reports on the Army Ocular Teleconsultation program reported an average response time of 5 hours and 41 minutes. The Military Orthopaedic Teleconsultation Program reported 7.54 hours for the average response time for teleconsultations. In contrast, the average initial response time for FOXTROT during beta testing in Afghanistan was 3 minutes 58 seconds. FOXTROT was rated 4.7 on a 1-5 Likert scale (with 1 being unsatisfactory and 5 being outstanding) for all metrics.

FOXTROT met or exceeded ten performance indicators and quality metrics. The mean initial response time was 3 minutes 58 seconds \pm 3 minutes 48 seconds. All 28 (100%) consults were responded to within the requested time. Visual acuity was tested in both eyes in 18 (64%) consults. There was agreement between the teleophthalmology diagnosis and final diagnosis in 24 (86%) consults. In three (11%) of those cases, an ophthalmology evaluation was recommended because the diagnosis was uncertain based upon teleophthalmology consultation alone. Teleophthalmology consultation prevented the need for aeromedical evacuation in 4 (14%) consults and downgraded the category of precedence from urgent or priority to routine in 4 (14%) consults. The patient returned to duty in 15 (54%) consults. The consult record was uploaded in the Theatre Medical Data Store (TMDS) medical record in 27 (96%) consults. All 28 (100%) consults were secure and HIPAA compliant.

Users rated their satisfaction with FOXTROT using a 1-5 rating scale, with 1 being "very dissatisfied" and 5 being "very satisfied". Overall satisfaction was rated at 4.85 ± 0.45 , ease of use was rated at 4.74 ± 0.52 , satisfaction with the management and treatment plan was rated at 4.96 ± 0.19 , and satisfaction with FOXTROT compared with previous ophthalmology consults user has placed using other methods such as telephone, email, or pager was rated at 4.70 ± 0.66 .

Conclusion: Preliminary beta-testing demonstrated a proof-of-concept for FOXTROT in a combat zone. Use of the mobile application allowed forward providers at remote forward operating bases (FOBs) throughout Afghanistan rapid access to sub-specialty expert opinion through teleophthalmology consultations. This application enhanced the care for combat ocular trauma and laid the foundation for the preservation of vision in these challenging cases. FOXTROT also prevented unnecessary aeromedical evacuations for disease non-battle injuries and generated a positive return on investment.



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FOXTROT Mobile Eye Care App



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An Introduction to the Award Winning Application Aimed at
Reducing Aeromedical Evacuation and Improving Soldier
Readiness

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Purpose: To provide an introduction to FOXTROT and explain the importance of this project to the Aeromedical Aviation community.

Agenda:

1. Background
2. Mission
3. FOXTROT Team
4. FOXTROT
5. Military Relevance
6. Results of Operational Pilot
7. Results of Garrison Pilot
8. Next Steps
9. Summary



Background



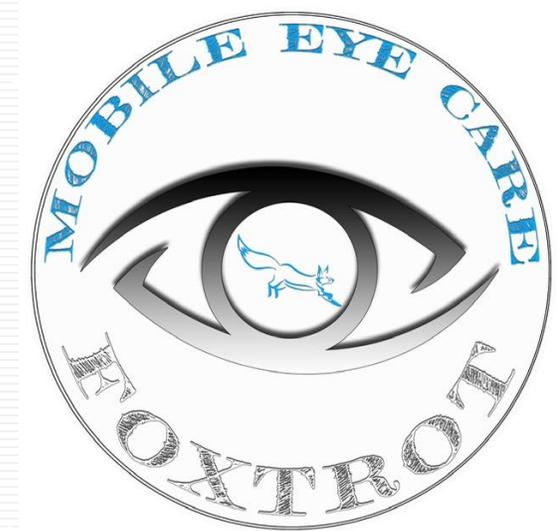
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Combat eye injuries remain a significant cause of disability among wounded Warfighters despite the use of combat eye protection.

These injuries are life-changing for the patient, and incur long-term cost in terms of lifetime treatment, rehabilitation, loss of potential income and associated psychological strains.

From 2001 to 2017, there were over 6,000 military eye injuries with a high risk of blindness, with 43% of these patients ultimately going blind in at least one eye (Frick, 2019).





Background



Delayed treatment of eye injuries resulting from combat significantly increases the likelihood of poor visual outcomes for patients.

Despite the high incidence of combat ocular trauma (COT) and ophthalmic disease non-battle injury (DNBI) within the operational environment prior to FOXTROT, there were limited options for teleophthalmology at forward operating bases (FOBs).





Background



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Based on peer-reviewed published data from 2000 to 2010, the total incident cost of eye injury in the military each year in this 10-year timeframe has been \$2.282 billion. This cost represents eye injury that may or may not result in permanent visual impairment or blindness (Buckingham, Whitwell, & Lee, 2005).



Buckingham, R. S., Whitwell, K. J., Lee, R. B. (2005). Cost analysis of military eye injuries in fiscal years 1988-1998. *Military Medicine*, 170(3), 196-200.

The Tyranny of Distance and Air/Area Denial





Future Multi-domain Operations (MDO) will challenge aeromedical evacuation.

Medical evacuation out of theater will take longer and the “golden hour” of point of injury evacuation will no longer be possible.

We needed a solution for medics on the battlefield to get real-time advice on how to treat battlefield injuries because patients are not going to reach higher echelons of care quickly in future warfare.





Mission



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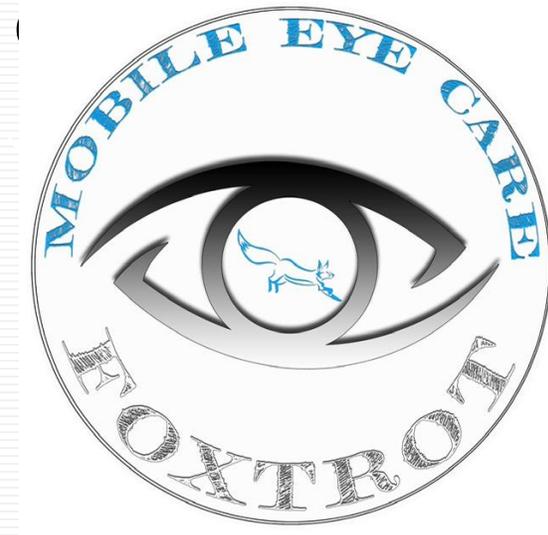
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Develop an operationally secure, Health Insurance Portability and Accountability Act (HIPAA) compliant, mobile application (mApp) to provide ophthalmic care to any remote deployed location through teleophthalmology.





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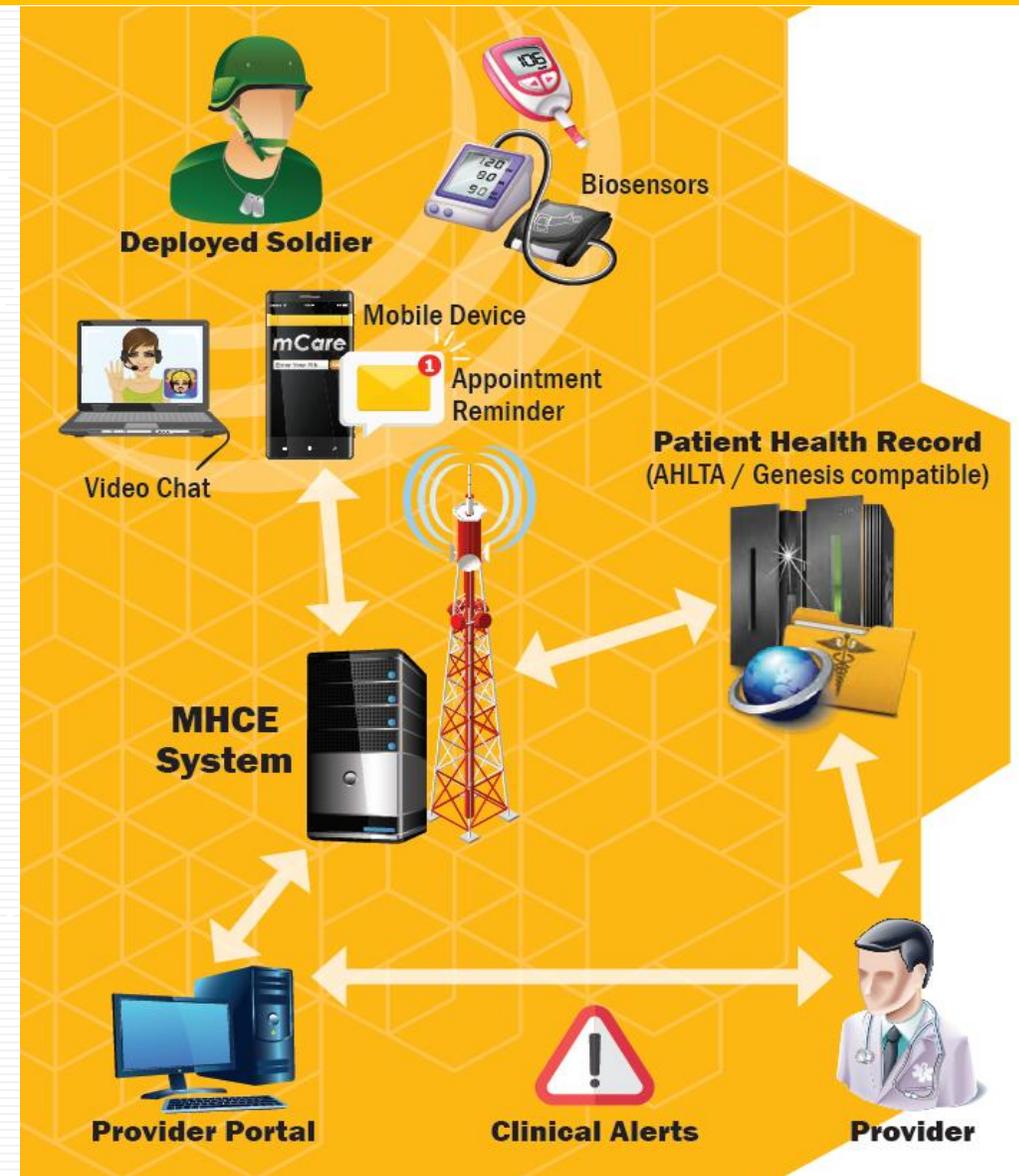
FOXTROT is a secure mobile environment for provider-to-provider communication and Artificial Intelligence (AI) to potentially prevent evacuation. It also functions as an Electronic Medical Record (EMR).

- Modified commercial off the shelf/Government off the shelf (COTS/GOTS) technology
- HIPAA-compliant
- Leverages end-user mobile devices (cell phone or tablet) in a manner distinct from text messaging or email
- Operates on all major cell phone platforms
- Requires two-factor authentication
- National Institute of Standards and Technology-certified encryption (Federal Information Processing Standard [FIPS] 140-2) for both data-at-rest and in-transit
- Functions in both synchronous and asynchronous modes

FOXTROT recently won the 2020 FedHealthIT Innovation Award as well as the 2019 Army Modeling and Simulation Award.



- Valid Authority-to-Operate (ATO)
- Security Software has a Certificate of Networkiness (CON)
- Valid Privacy Impact Statement (PIA)
- HIPAA-compliant



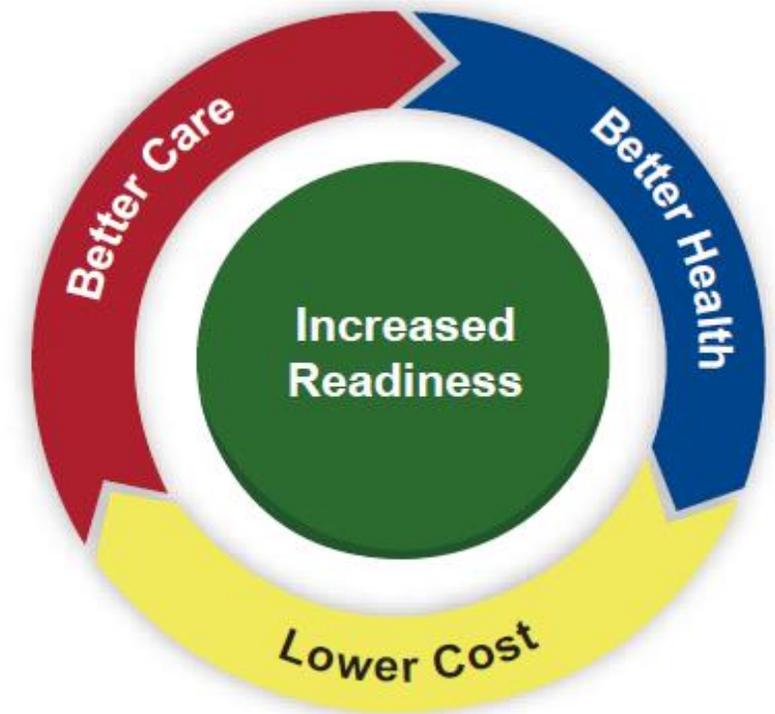


Telemedicine is a military priority.

FOXTROT improves the readiness of the Force in combat and frontline trauma environments.

FOXTROT improves the readiness of the fighting Force by resolving battlefield injuries in the battlefield. Just as important, FOXTROT will improve the clinical acuity of all providers using the application. The more trauma cases medical providers see, the more prepared we are for the next case.

Based on an independent assessment, FOXTROT would potentially save the Military \$4.5M by preventing costly medical evacuations out of theater every year.





Results of Operational Pilot



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Prior to exiting Afghanistan, our team piloted FOXTROT in Afghanistan for 3 months.

30 users at 16 locations in Afghanistan and 1 location outside of Afghanistan participated. There were 11 users at Role 1, 6 at Role 2, and 13 at Role 3.

29 consults placed over 6 weeks by 18 different users were received by the expeditionary ophthalmology team.





Results of Pilot



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Performance Indicator or Quality Benchmark*	
Initial response time – minutes: seconds	3:58 ± 3:48
Response within requested time – no. (%)	28 (100)
Visual acuity tested both eyes – no. (%)	18 (64)
Agreement teleophthalmology diagnosis and final diagnosis† – no. (%)	24 (86)
Treatment and management followed JTS CPG‡ – no. (%)	28 (100)
Prevented need for aeromedical evacuation – no. (%)	4 (14)
Downgraded category of aeromedical evacuation precedence – no. (%)	4 (14)
Return to duty – no. (%)	15 (54)
Consult record uploaded to medical record§ – no. (%)	27 (96)
Consult secure and HIPAA compliant – no. (%)	28 (100)

Table 1. Performance indicators and quality benchmarks for FOXTROT teleophthalmology mobile eye care consultations.

*Percentages were calculated from total number of 28 new consults placed. †There were 4 cases with disagreement between the teleophthalmology diagnosis and final diagnosis. In 3 of those cases, an ophthalmology evaluation was recommended because the diagnosis was uncertain based upon teleophthalmology consultation alone. ‡For each consult it was determined if treatment and management followed recommendations outlined in the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Eye Trauma: Initial Care. §In one consult, the patient was not able to be located in the medical record using name, date of birth, or Department of Defense Identification Number, so the FOXTROT consultation could not be uploaded to the medical record.



User Satisfaction	
Overall satisfaction	4.85 ± 0.45
Satisfaction with ease of use	4.74 ± 0.52
Satisfaction with the treatment and management plan	4.96 ± 0.19
Satisfaction compared with other teleophthalmology methods†	4.70 ± 0.66

Table 2. Users graded their satisfaction with FOXTROT using a 1-5 rating scale, with 1 being “very dissatisfied” and 5 being “very satisfied.”



Results of Garrison Pilot



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Performance indicator or quality benchmark	Number (% ^a)
Average response time (min) +/- SD	11.8 ± 14.6
Response within requested time	95 (96.0)
Teleophthalmology diagnosis recorded ^b	81 (81.8)
Final diagnosis recorded ^c	66 (66.7)
Consults with both a teleophthalmology and final diagnosis ^d	50 (50.5)
Visual acuity tested in both eyes	56 (56.6)
Uploaded to medical record ^e	98 (99.0)
Errors in app/communication, reported ^f	10 (9.2 ^f)

a. Percentage calculated based on the total completed consults: 99. b. teleophthalmology diagnoses were unavailable for 18 consults because not enough information was available to make a diagnosis, or one was not recorded. c. Final diagnosis determined at time of follow up, if follow up was recommended by the consulting ophthalmologist. If no follow up was recommended, or patient did not present for follow-up, diagnosis was determined based on the next appointment, if available. d. Of the 99 completed consults, both a teleophthalmology diagnosis and a final diagnosis were recorded in 50 with agreement in 40 of these (80.0% of completed consults with both diagnoses listed). e. For one consult, errors with the user's account prevented uploading the consult to the patient's medical record. f. Of the 109 consults recorded, 10 were unable to be completed due to errors in the application itself or due to system errors. g. The denominator for this percentage was the total number of consults placed: 109.

109 consults placed at the Malcolm Grow Medical Clinics and Surgery Center (MGMCS) at Joint Base Andrews were collected from October 2020 to January 2022.



Next Steps



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- Incorporate more Artificial Intelligence
- Incorporate more service lines
- Roll FOXTROT out to more treatment facilities
- More field testing

In 2020, prepare for Virtual Health Care to take center stage in the DHA.



It is convenient, demanded from congress, and value is optimized to serve as a valid option in healthcare.



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DEPENDS ON THE MILITARY HEALTH SYSTEM

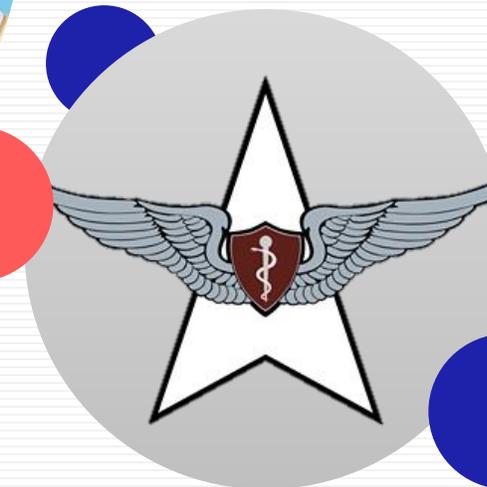


Questions?



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