Advanced Virtual Support for Operational Forces: A 3-Year Summary

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ABSTRACT

Introduction:
The Military Health System mission is to provide medical care throughout the globe to service members and beneficiaries. To achieve this mission in the most austere of locations, telemedical support is an essential force multiplier when robust in-person medical support is not feasible. This led to the development of a telemental solution initially known as the Virtual Critical Care Consultation service which provided tele-critical care assistance to downrange providers. The VC3 system then expanded to include multiple medical specialties available for consultation. The current version of this telemental solution is the ADvanced VrVirtual Support for OpeRational Forces (ADVISOR) program which is a synchronous and asynchronous telemental system that was developed to provide 24/7 remote expert support to military clinicians engaged in casualty care in austere and operational environments.

Materials and Methods:
This manuscript reviews the ADVISOR program data collected from 2017 to 2020 and provides a rough order of magnitude for return on investment. We reviewed data collected by Operational Virtual Health Reports and Operational Virtual Health Evaluations following synchronous consultations. Part of the data reviewed was available patient demographic data, local caregiver information, the purpose of the consult, recommendations made during the consult, the technology used during the consult, and the patient disposition. They also recorded the evacuation plan for the patient and whether a medical evacuation was escalated (e.g. changed from routine to urgent, or from urgent to critical care air transport), downgraded (e.g. urgent to routine), or avoided altogether based on the telephonic consultation.

Results:
There were a total of 156 real-world calls during the evaluation period. The total cost savings for these calls was $1,097,027 (3-year program costs of $909,973 less an average of $87,261 per call or $2,007,000 total) from downgrading or avoidance of planned evacuations. The unmeasured value associated with ADVISOR consultations should also be commented on. For example, when evacuation plans are escalated based on remote expert consultation, it is probable that the escalation increases patient safety and may avoid medical complications that would result in longer term medical costs to the government.

Conclusions:
Based on the collected information, the financial return on investment has exceeded costs and the system is perceived as being valued added for both local caregivers and remote experts. The system appears to help optimize evacuation planning, specifically by downgrading or eliminating unnecessary evacuations.

INTRODUCTION

The ADvanced Viirtual Support for OpeRational Forces (ADVISOR) program is a synchronous and asynchronous telemental system that was developed to provide 24/7 remote expert support to military clinicians engaged in casualty care in austere and operational environments. The ADVISOR program is an evolution of the Virtual Critical Care Consultation (VC3) service, the ADvanced Virtual Support for Special OpeRations (ADVISSOR) system, and the Synchronous Telemedicine Specialty Support to Special Operational Forces (STS3). In August 2015, the Special Operations Medical Association’s Prolonged Field Care (PFC) Working Group collaborated with critical care physicians at the U.S. Army Institute of Surgical Research to create a solution to address the ninth PFC core capability: obtain telemental consultation. The VC3 service was developed to deliver advanced critical care consultation to Special Operations Forces (SOF) medics any time, anywhere at low cost, and with little technology. Calls to the VC3 service were directed to an on-call critical care physician’s mobile phone. An email distribution list allowed local caregivers to send images and/or background information—devoid of personally identifiable information (PII) and operationally sensitive information—before calling. A VC3 call
The ADVISSOR project sought to merge the VC3 project and the STS3 project to reduce customer confusion and to provide needed enhancements to both. The new ADVISSOR system expanded access to other specialties besides critical care and introduced an automated call distribution (ACD) system that reduced the risk of missed calls. The ACD was designed with significant redundancy: in the event, the primary on-call physician was unable to take a call, the ACD transfers the call to a back-up physician, and if that physician was also unable to connect, it transfers the call to a 24/7 staffed emergency department. The initial call system included call rosters for critical care, general surgery, orthopedic surgery, infectious disease, dermatology, and an emergency department at a large medical center for access to all other specialties not listed.

The ADVISSOR system transitioned to the ADvanced VIRTUAL Support for OpeRational Forces (ADVISOR) system in 2017 when two events occurred: the new Defense Health Agency’s (DHA) Virtual Medical Center (V-MEDCEN or VMC) was opened at Brooke Army Medical Center and the ADVISSOR system was made available for all operational forces, not only SOF. The VMC also integrated additional projects to make a full spectrum OVH solution responsive to clinical context (direct to patient care or consultative support) and the urgency of the care need (routine, urgent, or emergent) (Table I). Last, the synchronous consultation specialty options were updated to remove dermatology (mostly using asynchronous support) and to add the following: toxicology, pediatrics, U.S. Army Burn Center, hematology/oncology, chemical casualty support, and veterinary services.

ADVISORS (remote experts who take calls) are credentialed staff physicians located across the MHS and usually take calls for ADVISOR in addition to other clinical duties. Given the overall call volume of the system, this “volunteer” model has been sustainable thus far. Recommendations made

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**TABLE I.** The ADVanced VIRTUAL Support for OpeRational Forces (ADVISOR) System Provides Synchronous and Asynchronous Teleconsultation Support for Deployed Military Caregivers. The Type of Support and Interface Platform Depends on the Urgency of the Consult. Direct Patient Care Telemedicine Is Not yet Incorporated into the ADVISOR System, but Is Supported by Other Solutions in Pilot Projects

| Type of Support | Interface Platform |
|-----------------|--------------------|
| Emergent virtual critical care | Synchronous phone through automated call distribution (ACD) system; can be escalated to real-time video depending on local capabilities |
| Urgent specialty services | Consult within minutes |
| Routine | Consult within minutes |
| Direct care | Consult within minutes |

**Advisor**

- Consult within minutes
- Life-threatening or potentially life-threatening conditions like:
  - Shock
  - Respiratory failure
  - Renal failure
  - Liver failure
  - Complex wounds
  - Polytrauma
  - Burns
  - Severe infection/sepsis
  - Crush injuries
  - Severe electrolyte abnormalities
  - Encephalopathy/severe TBI
  - Abnormal vital signs
  - Complex arrhythmias
  - Poisonings

**Web portals**

- HELP
- PATH

**Other solutions**

- Varies by region

- Emergent virtual critical care
- Urgent specialty services
- Routine
- Direct care

- It must always be planned ahead of time
- Direct patient care is “not” teleconsultation
- DC uses VTC to evaluate and treat patients who are in a different location

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4HELP, Health Experts onLine Portal.
5PATH, Pacific Asynchronous TeleHealth.
TBI, traumatic brain injury; DC, direct care; VTC, video tele-conference.
by ADVISORS are consultative in nature: primary responsibility and thus final decision-making about a patient’s care remain at the discretion of the local caregiver. Quality of consultation is monitored by surveys of the local caregivers (OVHEs, see below). No outcome data and rare documentation of patient care are available, and thus, accuracy of diagnoses or “correctness” of recommendations cannot be evaluated.

This manuscript reviews the ADVISOR system data collected from 2017 to 2020 and provides a rough order of magnitude for return on investment (ROI).

**METHODS**

We reviewed data collected by OVHRs and OVHEs (Figs. S1 and S2 in Supplementary Material). OVHRs are reports completed by remote experts (i.e., “advisors”) following synchronous consultations. Using OVHRs, advisors record available patient demographic data, local caregiver information, the purpose of the consult, recommendations made during the consult, the technology used during the consult, and the patient disposition. The OVHR does not collect any PII or protected health information as it is not for medical encounter documentation. Primary medical documentation is the responsibility of the local caregiver; however, if the patient is a U.S. service member and operational security allows identification of the patient, the advisor will also document the encounter in military electronic medical records. Using OVHRs, advisors also rate the quality of each encounter with respect to experience with the local caregiver, appropriateness of questions for telemedicine consultation, ability to provide appropriate recommendations, and any suggestions to improve the system. OVHRs are sent to the advisor who is identified by their phone number in the ACD system.

Importantly, OVHRs also record the evacuation plan for a patient and whether a medical evacuation was escalated (e.g., changed from routine to urgent or from urgent to critical care air transport), downgraded (e.g., urgent to routine), or avoided altogether based on the telephonic consultation. By using published aircraft operational costs, we are able to determine the cost of evacuation based on the patient’s geographic location to the Landstuhl Regional Medical Center (LRMC).5,6 To identify the location of origin, we first used data from OVHRs. If location data were not recorded on the OVHR, we used the ACD system to identify where incoming calls originated using commercial area/country codes or defense switch network numbers. Overall, this is a very conservative cost estimate as it does not account for all actual costs incurred with evacuation, such as personnel time, commercial transportation/evacuation costs, lost duty hours, or the impact on the unit’s mission.

After a call is received, the VMC ADVISOR support team also attempts to identify the local caregiver either by calling the originating phone number in the ACD system or through the advisor completing the consult. If the team identifies the local caregiver, it sends an OVHE form to obtain feedback from the local caregiver about his or her experience with the ADVISOR consultation.

**RESULTS**

There were a total of 156 real-world calls during the evaluation period. Call volume increased over time (Table II). Seventy-nine calls did not produce any data, other than the origin of the call and service requested and thus could not be evaluated. Of the remaining 77 calls, 57 were for DoD beneficiaries where evacuation was possible. Of the 57 calls, 23 produced enough data to determine if the evacuation plan was altered. According to available data, the ADVISOR system helped downgrade the priority of 6 evacuations and completely avoid 17 evacuations altogether. No evacuation plans were escalated in this cohort. The total cost savings for these calls was $1,097,027 (3-year program costs of $909,973 less an average $87,261 per call or $2,007,000 total) (Table III, Supplementary Table S1).5,6 The costs of the program included an automatic call distribution solution and subsequently a staffed call center.

OVHRs provided insight from the advisors’ perspective. Average ratings are shown in Table IV. Ninety-five percent felt they had average/exceptional interactions with the local caregiver; 85% felt that the clinical questions were appropriate for a telemedicine consult; and 85% felt they could provide appropriate recommendations.

Average ratings from local caregiver OVHEs are shown in Table IV. These demonstrate that local caregivers had an above-average/exceptional experience 92% of the time when accessing the system, an above-average/exceptional overall experience with the advisor 91% of the time, that the advisor’s recommendations were above average/exceptional 93%
of the time, and that they could implement the advisors’ recommendations 89% of the time.

DISCUSSION

Data were collected from the OVHRs and demonstrated the significant impact of the ADVISOR system. While only 23 calls (39% of total calls, 40% of available data for DoD beneficiaries) had sufficient data to analyze, 23 calls affected the local care team’s evacuation plan. Consultations allowed planned evacuations to be downgraded or avoided for a total cost savings of $1,097,027. Unfortunately, the available data do not reflect the true value of the ADVISOR system: some consultations result in the escalation of evacuation priority and some have no impact on the evacuation plan (authors’ personal experience and communications). It is remarkable that the presented data from the synchronous ADVISOR system dramatically impacted 40% of evacuation plans in this cohort. Extrapolating these data to the entire cohort of known DoD beneficiaries in this report (an additional 24 patients) at the conservative estimate, the use of teleconsultation resulted in 4,146 non-missed days of work or school due to travel. They also found 98% patient satisfaction with emphasis on time and cost savings alone if the 1,886 patients had to travel to LRMC rather than medical facilities in the Pacific Region from 2006 to 2009. The system provided provider-to-provider pediatric subspecialty expertise via an asynchronous internet-based teleconsultation system. They reviewed 1,000 consecutive consultations and found that 74% of the consultations resulted in a change in diagnostic or treatment plan. They also found that PATH precluded medical evacuation in 12–43% of teleconsultations resulting in $208,283–$746,348 of annual savings.

Lin et al. performed a 1-year retrospective review of the Health Experts online at Portsmouth teleconsultation system launched in 2014. The system was launched to facilitate communication between specialists at the Naval Medical Center Portsmouth and providers on fleet forces as well as primary care clinics in the USA, Europe, and the Middle East. It was also an asynchronous, low-bandwidth, internet-accessible telecommunication platform. They evaluated 559 consults from June 2014 to December 2015. Fifty of those consults prevented medical evacuations, which translated to 80% ROI ($693,461) on the basis of prevented evacuations alone. Intangible savings such as lost productivity increased the ROI 250% ($1,337,628).

Published in 2017, Waibel and colleagues performed a 1-year retrospective review of healthcare encounters and patient satisfaction surveys from LRMC specialty clinics engaging in synchronous telehealth encounters to Army Health Clinics throughout Europe. During that year, 2,354 synchronous telehealth encounters took place for 1,886 unique patients and 31 medical specialties participated. They found that the use of synchronous telehealth saved $494,156.50 in travel expenses alone if the 1,886 patients had to travel to LRMC rather than be able to be seen virtually. They also found that as a conservative estimate, the use of teleconsultation resulted in 4,146 non-missed days of work or school due to travel. They also found 98% patient satisfaction with emphasis on time and cost savings for the patients.

The three previous retrospective analyses of DoD teleconsultation solutions demonstrate the financial benefits of utilizing teleconsultation that we also found in our review. They also demonstrate the unmeasured value of such programs toward improving readiness by keeping warfighters in the fight by reducing unnecessary evacuations. The ADVISOR system has demonstrated that it is a force multiplier for taking care of DoD beneficiaries downrange, helping build relationships with host nation partners, enhancing remote experts’ experience with operational contexts, and has paid for itself through cost savings to the DoD. It is in line with and defines the DHA “Quadruple Aim” of increased readiness, better health, better care, and lower cost. The ADVISOR system helps optimizing MHS operational readiness when utilized during field training exercises with medics; it enables globally integrated health solutions to combat forces using anywhere-to-anywhere technologies; it is easily deployable.

| Question | n  | Avg | SD  |
|----------|----|-----|-----|
| Experience with local caregiver | 101 | 4.31 | 1.11 |
| Local caregiver’s clinical questions were appropriate for virtual health consult | 101 | 4.28 | 1.36 |
| Ability to provide appropriate recommendations | 101 | 4.05 | 1.19 |
| Operational Virtual Health Evaluations (from local caregivers) | 79 | 4.32 | 1.08 |
| Accessing the consult system | 78 | 4.42 | 1.05 |
| Consultant recommendations | 75 | 4.35 | 1.25 |
| Ability to implement the recommendations | 74 | 4.18 | 1.38 |

*Based on the following 5-point Likert scale: 5—very easy/exceptional, 4—easy/above average, 3—neutral/average, 2—difficult/below average, 1—very hard/terrible, 0—no response.

Table IV. Survey Data
in the complex twenty-first-century battlespace; and it lowers costs as reviewed here.\textsuperscript{11,12}

Importantly, the inability to access remote expertise using telemedicine should not deter the continued evolution of virtual health solutions for the future operating environment. These solutions never “detract” from the baseline training a medic or medical provider should receive, but rather they add additional capability in situations where caregivers must, by necessity, operate outside of their normal scope of practice or beyond their baseline training. Similarly, novel solutions like artificial intelligence–enabled clinical decision support systems and autonomous solution are being developed to support local caregivers when communication is unavailable.\textsuperscript{13}

Future directions for the ADVISOR system will include expanded real-time video teleconsultation, remote monitoring (such as conventional tele-ICUs), as well as the ability to provide real-time remote tele-mentoring for advanced procedures (e.g., fasciotomy) in the austere, prolonged care settings.

This review is limited by a number of factors. Importantly, cost estimates in this report only reflect evacuation costs and assume that the remote experts’ recommendations produce best possible patient outcomes. It is possible that evacuation avoidance could produce unmeasured costs: delays in evacuation, additional costs by local care teams, or less favorable patient outcomes incur long-term medical costs. Furthermore, these cost and survey data only reflect a small proportion of total real-world calls. It is possible that the unmeasured calls could have a higher proportion of evacuation escalations leading to increased measured costs. However, as noted previously, escalations of evacuation priority or platform (e.g., commercial to military evacuation or medical to critical care air transport) would be expected to avoid significant long-term costs by avoiding adverse complications during evacuation. Similarly, it is possible that un-sampled advisors and local caregivers might have chosen not to submit surveys because they were afraid to reveal their negative opinions about the system. This is unlikely because (1) the surveys themselves are aggregated and not identified, (2) there are negative surveys in the cohort, and (3) the OVHRs and OHVEs, as well as the ADVISOR support team, specifically ask for feedback about how to make the system better. Overall, it is probable that the cost estimates reflected herein are conservative and that the survey feedback is an accurate reflection of the overall system. Data collected thus far do not provide outcomes metrics for comparison between patients cared for with and without the ADVISOR system.

**CONCLUSIONS**

The ADVISOR system is a synchronous and asynchronous telemedicine solution that links caregivers in deployed, operational environments to subject matter experts any time, day or night. It is the only sustained virtual health program supporting PFC. Based on the collected information, the financial ROI has exceeded costs and the system is perceived as being valued added for both local caregivers and remote experts. The system appears to help optimize evacuation planning, specifically by downgrading or eliminating unnecessary evacuations. Future efforts should focus on collecting data about patient outcomes.

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**SUPPLEMENTARY MATERIAL**

Supplementary material is available at Military Medicine online.

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**CONFLICT OF INTEREST STATEMENT**

None declared.

**REFERENCES**

1. Powell D, McLeroy RD, Riesberg J, et al: Telemedicine to reduce medical risk in austere military environments: the virtual critical care consultation (VC3) service. J Spec Oper Med 2016; 16(4): 102–9.

2. Nettesheim N, Powell D, Vassios W, et al: Telemedical support for military medicine. Mil Med 2018; 73(1): S459.

3. Ball JA, Keenan S: Prolonged field care working group position paper: prolonged field care capabilities. J Spec Op Med 2015; 15(3): 76–7.

4. Vassios W, Pamplin JC, Powell D, et al: Teleconsultation in prolonged field care position paper. J Spec Op Med 2017; 17(3): 141–4.

5. Griffith DA: Epidemiology, cost, and aircraft choice for aeromedical evacuation in AFRICOM. Theses and Dissertations. 2016; 364.

6. Office of the Under Secretary of Defense: Fiscal Year: Department of Defense fixed wing and helicopter reimburse- ment rates. 2019. Available at https://comptroller.defense.gov/Portals/45/documents/rates/fy2019/2019_b_c.pdf; accessed October 18, 2020.

7. Porch D: Bugeaud, Gallieni, Lyautay: the development of French colonial warfare. In: Paret P ed. Makers of Modern Strategy: From Machiavelli to the Nuclear Age. Princeton University Press; 1986:394.

8. Mahnke CB, Jordan CP, Bergvall E, Pinsker JE, Person DA: The Pacific Asynchronous TeleHealth (PATH) system: review of 1,000 pediatric teleconsultations. Telemed e-Health 2011; 17(1): 35–9.

9. Lin AH, Welstead BL, Morey BL, Mahnke CB, Cole JH, Johnston MG: Return on investment analysis of health experts onLine at Portsmouth: a 2-year review of the navy’s newest teleconsultation system. Mil Med 2017; 182(5–6): e1696–701.

10. Waiwel KH, Cain SM, Hall TE, Keen RS: Multispecialty synchronous telehealth utilization and patient satisfaction within Regional Health Command Europe: a readiness and recapture system for health. Mil Med 2017; 182(7): e1693–7.

11. Pamplin JC, Davis KL, Mbuthia J, et al: Military telehealth: a model for delivering expertise to the point of need in austere and operational environments. Health Aff 2019; 38(8): 1386–92.

12. Smith DJ, Bono RC, Slinger BJ: Transforming the Military Health System. JAMA 2017; 318(24): 2427–8.

13. Pamplin JC, Yeaw R, Gilbert GR, et al: Augmenting clinical performance in combat casualty care: telemedicine to automation. In: International Conference on Augmented Cognition 2018 Jul 15. Springer: Cham: 326–38.