5G Telemedicine & Medical Training

Update:
Exciting Future Awaits DOD Medicine

This article is the second in a series meant to inform Department of Defense medical personnel and affiliate partners about the exciting activities taking place, and future visionary events, which will enhance DOD medical support capabilities within the developing 5G core environment. This also serves as an update to the former “Technical Areas” that have been reestablished as “Use Cases” to match current Joint Base San Antonio 5G Core, testbed functions, and directives based on current mission set requirements or needs.

Overall, 5G is still in its infancy and almost all of the initial rollout has been focused on high-speed data for consumers, including fixed wireless access (home and enterprise broadband). However, the most transformational aspects of 5G are yet to come.

Since 5G is a critical strategic technology, the DOD must also master 5G networks, which will eventually touch every mission and operation, to include medicine. Although telemedicine is already happening today, it is often inhibited by a lack of adequate digital connectivity supporting the data speeds and volumes needed to provide real-time virtual healthcare.

By incorporating massive Internet of Things connections, and ultra-low
latency, with telemedicine applications, vast improvements in remote care and warfighter readiness are expected. This why the Office of the Undersecretary of Defense (Research & Engineering) selected Joint Base San Antonio as an experimentation site for 5G augmented reality support for telemedicine and medical training.

A formal Medical Steering Committee (MSC) has been established since October 2020, and includes vested partners from all DOD medical service components. It formally stands as the first level of strategic vetting for planning, programming, and facilitating medical aspects and issues to engage in emerging technology, which includes future applications for expeditionary medical operations.

The MSC serves as the initial point of entry for concepts developed through Program Element Monitors and Points of Contact relevant to medical care, technical programs, or future experiment additions.

As projects and programs grow, the MSC will remain functional as a senior executive oversight board for advice and technical expertise from various project teams, much like a board of directors, rather than having a purely technical focus.

The MSC’s unified subject-matter experts, community and facility leads, technical consultants, and resource stakeholders have collaboratively refined several medical outcome goals below, which include expectations from 5G. These seven goals remain pivotal within the 5G conduit for the telemedicine mission and its success. By accomplishing each goal, 5G in Telemedicine will soar to new heights, allowing providers and patients alike to stay at the forefront of new technology.

Goal 1: Define 5G host platforms capable of supporting medical professionals in their pursuit of saving lives and enabling preventive medicine.

Goal 2: Provide resiliently and fault-tolerant 5G Telemedicine and medical services deliverable anywhere in the world, enhancing U.S. national interests and military mission assurance.
Goal 3: Collapse time and space to achieve real-time, virtual and digital medical support.

Goal 4: Extend operational medical expertise virtually to enhance support for mobile forces to austere environments.

Goal 5: Ensure mission application security and electronic health record security in all medical and data-access applications.

Goal 6: Maintain an environment which allows DOD medicine and medical services to practice virtual medicine on-demand for optimum utilization of medical expertise.

Goal 7: Provide wireless services and new technologies in support of telemedicine applications in ordinary and adversarial environments.

These goals are paramount to the Joint Services’ medical missions, and to their success.

Support priorities for DOD medical services will remain a regular topic of discussion at the MSC, although mission directives, budget resources, and technical core, or testbed set up, have been slightly altered.

Because of complexities in 5G capabilities, and the operational diversities needed for telemedicine, use of applications under three use cases (Figure 1) are now being restructured and developed. These include:

- 5G Augmented Reality (AR)-Guided Enhanced Medical Training;
- 5G Tele-mentoring via AR for Medical Procedures (includes AR technology Enabled Remote Integrative Surgery – ARTEMIS);
- 5G Mobile Medic Environments.

These use cases will be shaped to bring medical providers the near real-time data and information they need in order to make the split-second decisions which may be critical in a variety of healthcare environments.

Due to the complexity of 5G capabilities, and the operational diversity
needed for telemedicine, this transformation will continue to expand based on future DOD telemedicine needs. In fact, JBSA’s 5G experiments will be used to demonstrate medical applications, including those using augmented/virtual/mixed reality (AR/VR/MR), artificial intelligence, machine learning, surgical procedures, and record data access or imaging viewing within massive sensor and IoT monitoring and control.

Figure 1: Operation Vision for Telemedicine and Medical Training

In the near future, 5G technology will enable a secure, resilient and fully integrated 5G platform to extend operational medical expertise forward to the "Operational Edge," providing virtual real-time medical training anywhere in the world, and will fuse together with other advanced technologies (e.g., AR, VR, and automated data analytics).
Future demonstration details of planned Use Case, technical area projects, are depicted below:

**Use Case 1 - 5G AR-Guided Enhanced Medical Training:**

The prototype and demonstration of 5G AR-Guided Enhanced Medical Training is intended to enhance in-garrison (on the actual post or station) or just-in-time (right before departing for deployment) medical readiness training. It will improve and/or augment
capabilities and accessibility to reliable and realistic scenarios which meet or exceed national providers’ standards. By integrating service extensions, such as AR, ML and AI, the 5G core network will enable a realistic and immersive medical training experience.

Capabilities for real-time medical tele-training can occur anywhere in the world, including training platforms, Military Treatment Facilities, and partner nation locations. Initially, AR/VR medical training programs based on realistic engagements or scenarios are envisioned for Paramedic-Emergency Medical Technician-Combat Medic certification as described in the American Medical Association and American Board of Medical Specialties National Clinical Practice Guidelines and also with Joint Commission patient outcome management standards for healthcare.

The training scenarios below are being utilized to focus on injuries or events which may be encountered in the battlefield, and which when severe enough, will require expeditious interventions to save lives.

- Trauma Scenario A – Left arm or lower leg amputation;
- Trauma Scenario B - Gunshot wound to right leg;
- Medical Scenario A - Multiple aspects of respiratory distress, including recognition of toxic gas exposure, which requires proper protective procedures. Advanced and Standardized Life Saving guidelines address anaphylaxis and reactive airway insults/disease - i.e., asthma attack;
- Medical Scenario B - Heat injury, including thermal burn injuries; and
- Medical Scenario C - Cold injury.

This use case will also include tracking of activities, progress, and skills verification, which will improve the efficiency and proficiency of medics, allowing them to meet or exceed national providers’ standards for medical care interactions.

**Use Case 2 - 5G Tele-mentoring via AR for Medical Procedures (including AR Technology Enabled Remote Integrative Surgery – ARTEMIS).**
The prototype and demonstration of **5G Tele-mentoring via AR for Medical Procedures** is to test and evaluate 5G capabilities in support of telemedicine/tele-mentoring technology and build robust remote medical capabilities. In this instance, 5G will enable AR and VR to optimize reach-back capability for medical care at in-garrison or forward operating locations when specialized medical expertise is not available and transportation is constrained by geographic or facility limitations.

Medical expertise for invasive procedures, which is usually based at a central location, will be available at the point-of-need, thereby maximizing combat power forward. In addition, 5G has the potential to extend the reach of remote surgical interventions in forward care settings using compact tele-surgical robot platforms controlled by remote surgeons. The 5G-enabled AR-based systems enable high-fidelity, bi-directional specialized medical and surgical consultation by a remote expert. Advances in AR technology will allow virtual information to be holographically inserted into the field of view of the user. Additionally, 5G-enabled, low latency access to health networks, patient Electronic Health Records, high-resolution digital imaging, and physiologic data from enhanced sensor monitoring will greatly assist with physical interventions or interactions.

**Use Case 3 - 5G Mobile Medic Environments:**
The prototype and demonstration of **5G Tele-mentoring via AR for Medical Procedures** is to provide critical life-saving treatments to wounded soldiers in the field. Under field and combat conditions, rapid triage, diagnosis, and treatment saves lives. Military mobile medics are highly trained to work under adverse and often hostile conditions while treating physical trauma and life threatening wounds received in the field. However, having real-time access to knowledge and expertise to assess, diagnose, and complete complex procedures and protocols to treat critical wounds could save lives and reduce warfighter attrition due to debilitating injuries. Under this application, 5G systems optimize the effectiveness and efficiencies of mobile medical personnel when constrained in any environment which limits access to a definitive/specialized medical care facility. This application creates resilient, real-time reach-back capability for tactical, naval, or airborne-platform medics by enabling real-time remote primary care support or multi-specialty access from extenders, credentialed caretakers, and specialists, thereby improving point-of-need care. Improved care at the remote facility could mitigate the need to transport patients to higher levels.
of care, thereby maximizing combat power forward. As an added benefit, by virtue of interaction with remote medical experts, field medics have an opportunity to increase their clinical skills and abilities.

The JBSA Medical community eagerly looks forward to future engagements that will lead toward allowing AR/VR, AI and ML to interact with both providers and patients in real-time. As the experiments progress, they will be extended and incorporated into relevant DOD applications for warrior health support.

The 5G prototypes and experiments which focus on future medical needs and requirements for advanced training and telemedicine will optimize DOD medical care. By building global medical capabilities, with assistance also to mobile medical capabilities, it will transform how healthcare is delivered and open standards as a knowledge and force multiplier. The use of 5G will expedite the exchange of visual, sensory, auditory, haptic, and robotic control to decrease workload since 5G technology offers massive connection and fast speeds, including Ultra Reliable Low Latency Communications (URLLC), Enhanced Mobile Broadband (eMBB), and massive Machine Type Communications (mMTC).

The DOD Medical community could greatly benefit from 5G for enhanced medical training, tele-mentoring, and mobile medic operations. It would enable Joint Service operational medical expertise to be extended forward for integrated, efficient, and effective employment and would provide feasible means and avenues for real-time bi-directional, global tele-presence from health care professionals anywhere in the world on-demand. An exciting future awaits DOD Medicine, and the MSC is honored to be at the JBSA center of excellence as the facilitating council for part of its development.

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