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The Proving Ground: Validating Innovation through Experimentation

LTC Angela Samosorn PhD[1], Nicole Caldwell MA, RN[2], David Luellen MBA, BS[2], Sidney Cox MS[2], Jose Salinas PhD[2], LTC Gary Legault MD[2], Sena Mike MS[2]

[1]US Army Medical Activity-Alaska, Fort Wainright, AK , [2]US Army Institute of Surgical Research, JBSA, San Antonio, TX

Mixed Reality Clinical Decision Support

To address the complex clinical challenges of burn casualty care and emergent surgical interventions in austere environments, researchers at the US Army Institute of Surgical Research (USAISR) developed two novel mixed reality (MXR) clinical decision support (CDS) applications.

MXR-CDS applications developed included:
1) MXR-CDS Burn
2) MXR-CDS Surgical

These applications were tested during Project Convergence Capstone 5 (PC-C5), to enhance diagnostic and therapeutic accuracy and inform future advancements in military trauma interventions.

Why Experimentation?

Military field experimentations allow researchers to gather critical feedback on system performance, user interaction, and practical challenges that are impossible to simulate in a traditional laboratory setting.

Methods & Materials

Platform: USAISR developed software for burn care, cricothyrotomy, and chest tube insertion deployed on Microsoft HoloLens 2, assessed at a Technology Readiness Level of 5 (TRL 5).

Training Phase: Multiple user groups trained in use of the software and hardware prior to going to the field. Training lasted about 30 minutes per group. Supplementary training to reinforce MXR CDS use provided for field "super-users."

Execution: Devices were deployed for field use, Role 1 (2 headsets) and Role 2 (1 headset). To maintain experiment integrity, no researcher-user interaction was permitted unless user experienced a critical system failure.

Data Collection: Two-week evaluation utilizing user surveys, formally disseminated through Army Futures Command (AFC)/MED CDID. Research team observed use and overheard anecdotal comments during experimentation.

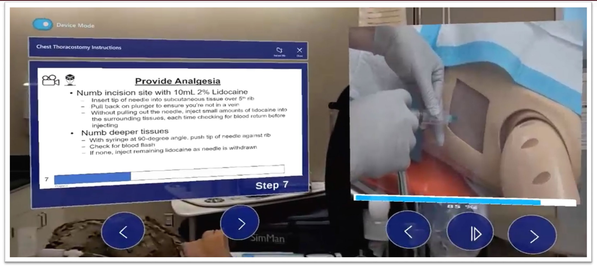

Figure 1. MXR-CDS Surgical: Step by step instructions with video

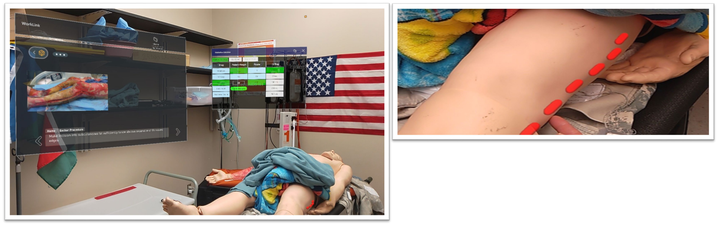

Figure 2. MXR-CDS Burn: Step by step instructions with video, medication calculator, and holographic cut lines

Observations

Mental Model Shift: PC-C5's high-fidelity Large-Scale Combat Operations (LSCO) scenario exposed a critical disconnect between lab-based theoretical workflows and actual field application.

User-Centric Redesign: Observing unscripted patient flow and organic equipment interaction reshaped our approach to user-centric design.

Actionable Insights: This unfiltered experimentation yielded unbiased insights, identifying crucial improvement areas that laboratory testing alone could never reveal.

From the Field

Primary Usage by Role: Role 1 primarily utilized the cricothyrotomy procedure guidance. Role 2 primarily utilized the chest tube procedure guidance. Only minor burn patients were presented therefore, reducing opportunities for testing of the MXR-CDS Burn app.

Usability & Training: “Super-users” organically taught other medics how to use the applications in the field, proving high intuitiveness of the user interface.

System Resilience: Localized MXR-CDS applications on the HoloLens did not require connectivity, therefore connection disruptions in the austere environment did not impact usage of apps.

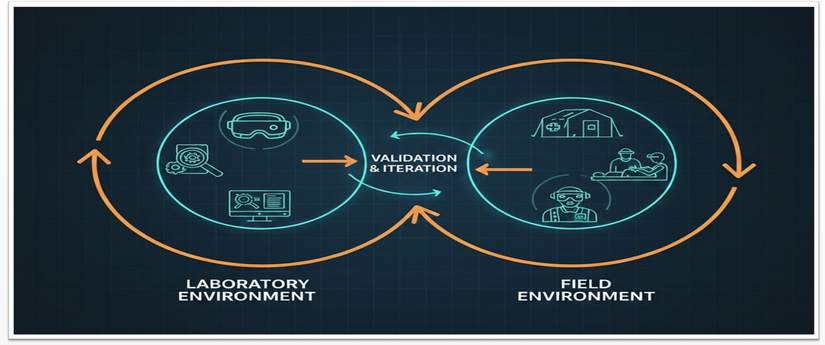

Figure 3. Laboratory and field environment integration cycle for validation and iteration

Limitations

In the Field: Researchers experienced a lack of control over weather (conditions were windy, rainy, hot, and even snow), injury patterns, types of casualties presented, and patient movement timeframes.

Data: Researchers did not see participant questionnaires until day before experimentation started. Questions were developed and data analyzed separately by external teams.

Lessons for Success

Pre-Experimentation: Start planning early. There are a lot of meetings and potential TDYs for planning and network security. Create short and long versions of technology training.

During Experimentation: Put short, laminated, instructions for users in tech cases. Attend any briefings related to the day's events, scenarios, or daily debriefs. Manage expectations. Understand how you become an observer.

Conclusion

The Advantage: Testing devices in realistic, unscripted field environments gathers critical feedback on system performance. These include user interaction, direct observation of patient flow, and the ways end-users organically interact with the equipment.

Next Steps: Incorporate lessons learned for future experimentation.

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