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Medical Modularity and Interoperability: How will we get there?

M. Beth H. Pettitt, Ph.D, US Army, CCDC Soldier Center, STTC

Jack E. Norfleet, Ph.D, US Army, CCDC Soldier Center, STTC



Outline

- **Introduction**
- **Working Towards Formal Requirements**
- **History of Interoperability Efforts**
- **Interoperability Demonstrations**
- **Recommendations and Conclusions**

Introduction

- Medical Simulation Technology
 - From Wax and Wood (2050 BC) to Plastics, 3D Printing, and Computers
- Away from “See one, do one, teach one” → To Holistic, Immersive, Objective training
- Fueled by Tactical Combat Casualty Care (TC3)
- Challenges:
 - Pre-hospital Levels of Care and Transport
 - Disconnect from task based training and full patient treatment
 - Lack of formal requirements documents
 - Automated assessments
 - Interoperability and standards



Working Towards Formal Requirements

CBA Prioritized Gaps (2020)

Lack Performance Measures & Feedback

Lack Standardization/Standards of Practice

Training Facility Limitations

Lack Trained SIM Operators/Evaluators

Lack Operational Realism

Lack Physiological and Behavioral Realism

Limited Availability/Usability

Lack Replication of Disease/Injuries to meet training needs

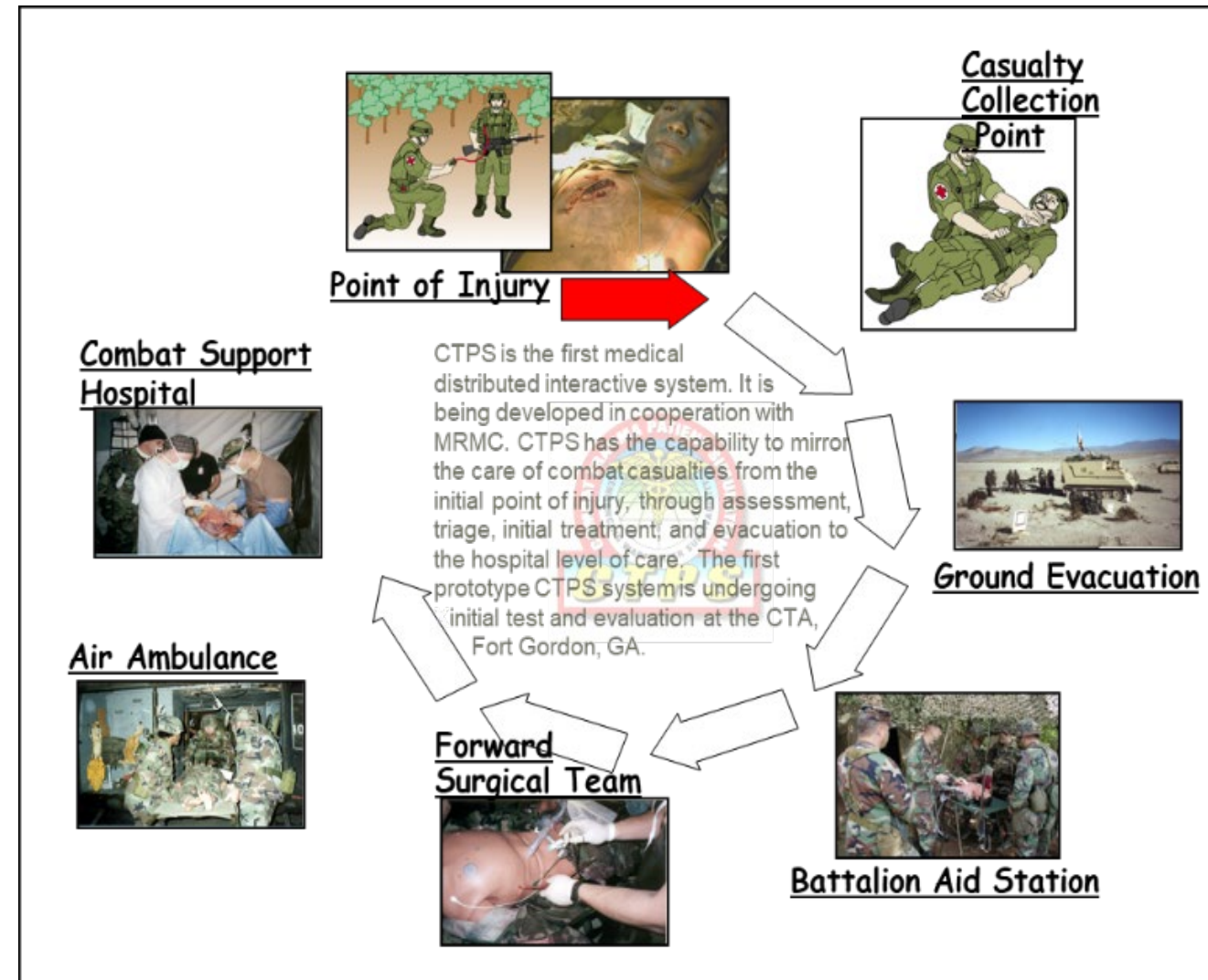
Lack Dynamic Capability –incorporating changes over time

Lack Incorporation and Integration of existing & new Medical Equipment and Technology

- (U) AFC Concept Required Capability - provide timely and appropriate medical care, treatment, and multi-modal evacuation over greater distances and for longer durations
- (U) Official MSTC Next Gen (MSTC-NG) Requirements Document Update, from the MedCOE DoS - Draft CDD

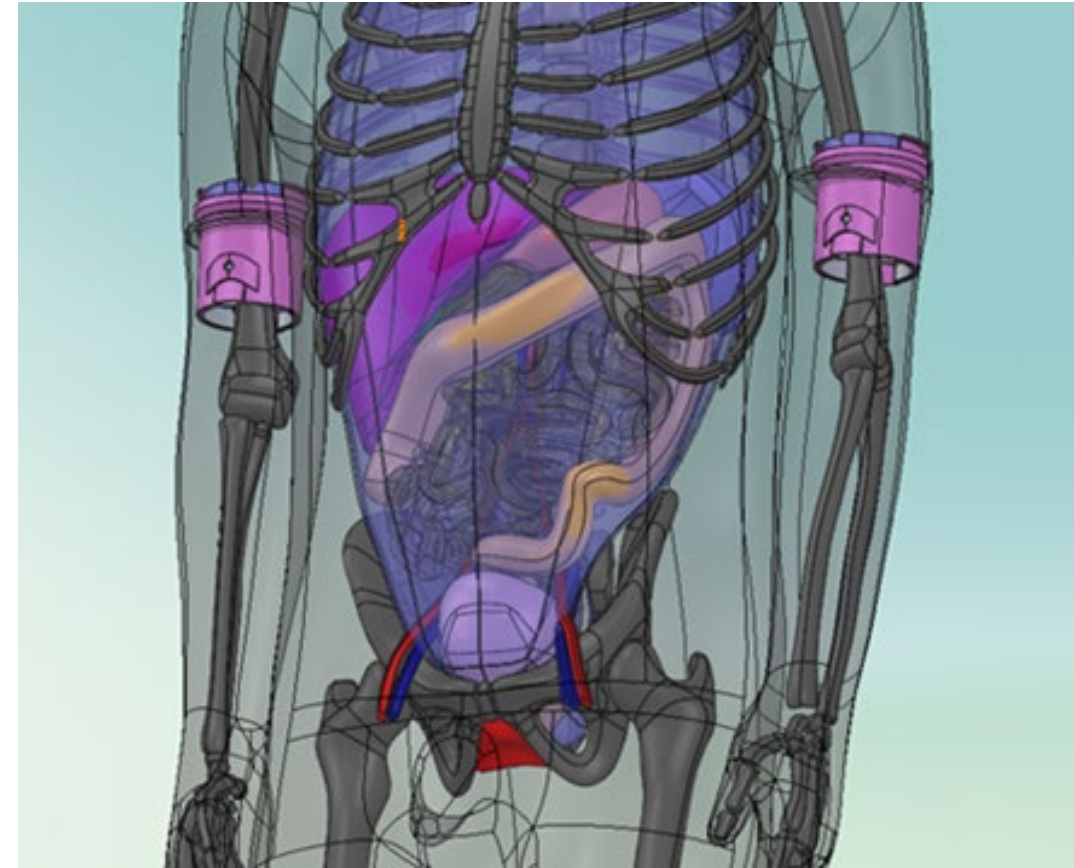
Past Examples of Interoperability

- Combat Trauma Patient Simulation (CTPS), circa 2000
 - The Army's first medical simulation research program demonstrating interoperability
 - Integrated using High Level Architecture (HLA)
 - Used DIS published data from Multiple Laser Engagement System (MILES)
 - Basic patient information shared across network



Past Examples of Interoperability - 2

- Advanced Modular Manikin (AMM) Program
 - Not a manikin, but rather simulation standards (circa 2018)
 - Facilitates the integration of micro subsystems
 - Physiologies
 - Connectors
 - Colors
 - Task trainers
 - Lack of mandates resulted in industry ignoring the program
 - Now known as the Modular Healthcare Simulation and Education System (MoHSES)



Interoperable Prototype Systems

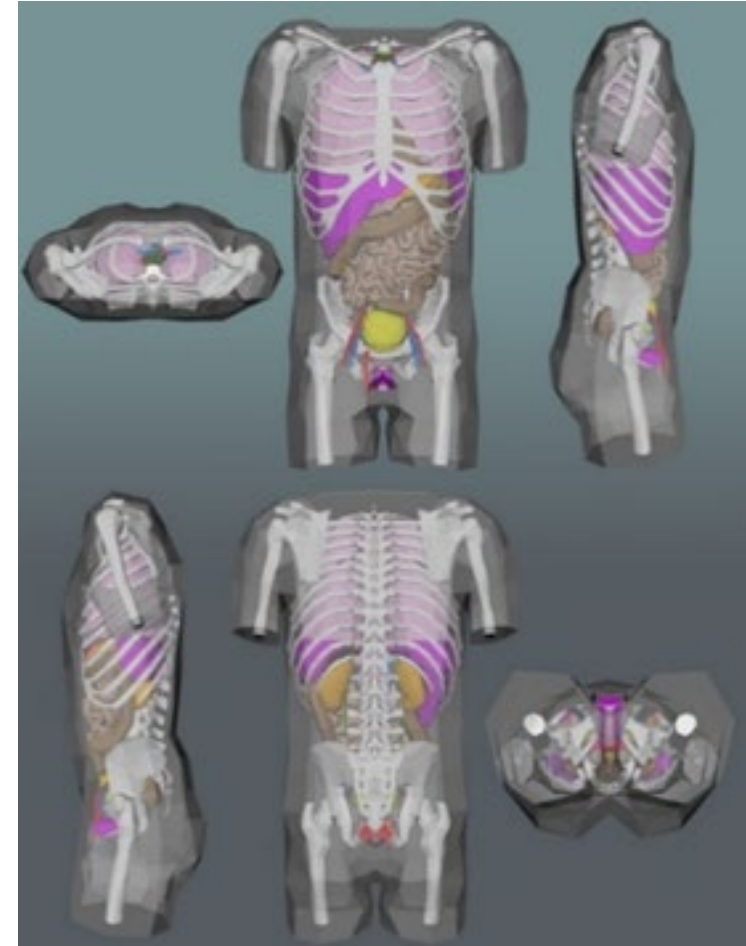


System	Pros	Cons/Challenges
Combat Trauma Patient Simulation (CTPS), early 2000's	Incorporated legacy and current simulation capabilities; HLA certified	Army specific; no formal requirement
MoHSES, formerly AMM, ~2018	Defined a design standard; incorporated multiple vendor capabilities into one training solution	Funding ended before project completion; no formal requirement
SPEARPOINTS/AJOMS	Formal requirement developed; Joint	Vision not yet fully realized; potential requirement expansion
Medical Extended Reality Research (MxRR)	Built on TC3Sim which has undergone formal V&V	Research environment; perhaps too focused on haptic solutions
Vision-based Intelligent Systems Used for Assessment and Learning (VISUAL)	Camera agnostic, open source built to read inputs published to the net	Requires significant graphics processing power and bandwidth to operate in near real time
Multi Modal Medical Training System (M3TS)	Exploring interoperability with multiple technologies	Research environment
Modular Female	Striving for true modularity with "current" technology	Current partial solutions; waiting to see if industry will work together



Interoperability Technologies

- CTPS (Combat Trauma Patient Simulation)
 - Origin of medical simulation and training interoperability
 - HLA Certified
 - Provided after-action review based on performance
 - No formal requirement
- MoHSES/AMM (Modular Healthcare Simulation and Education System/Advanced Modular Manikin)
 - Demonstrated extreme modularity
 - Scalable to any size or form factor
 - Lost funding
 - No formal requirements



MoHSES Model

Interoperability Technologies

➤ SPEARPOINTS

- In use by SOCOM since 2020
- Microcosm of applications using one vendors integration standards
- Forced government prototypes to take on the legacy interoperability constraints
- Led to proposal of Advanced Joint Operational Medical Simulation (AJOMS)

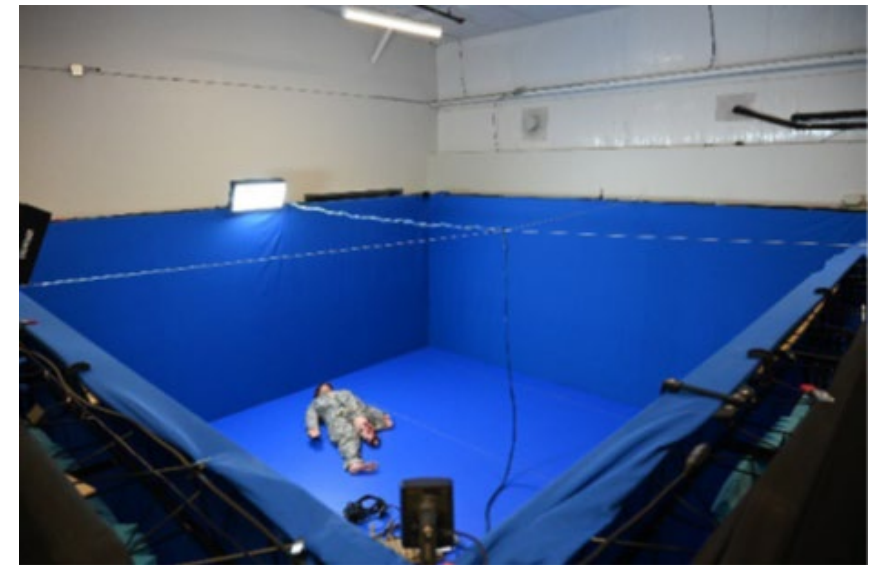
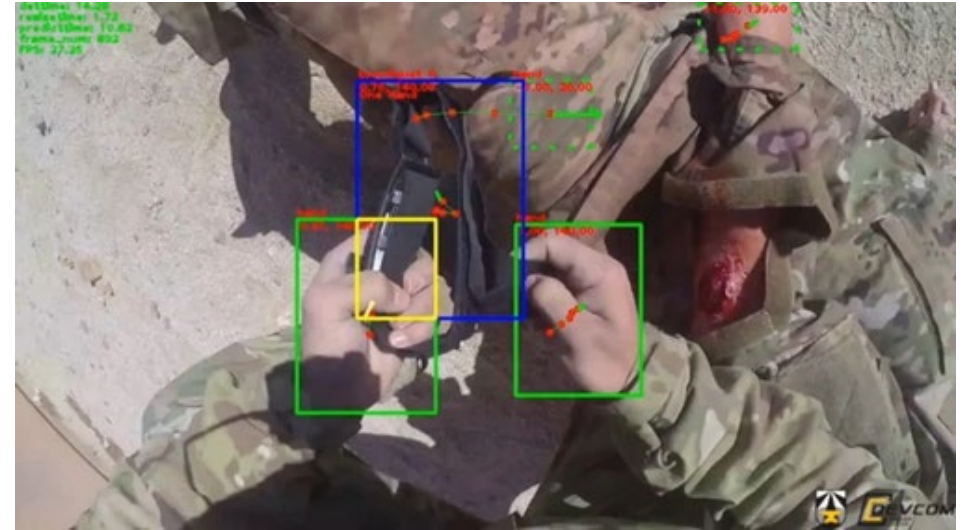
➤ Medical Extended Reality Research (MxRR)

- Allowed simulation with virtual patients and manikins
- Used to test interoperability claims
- Lack of formal requirements and funding

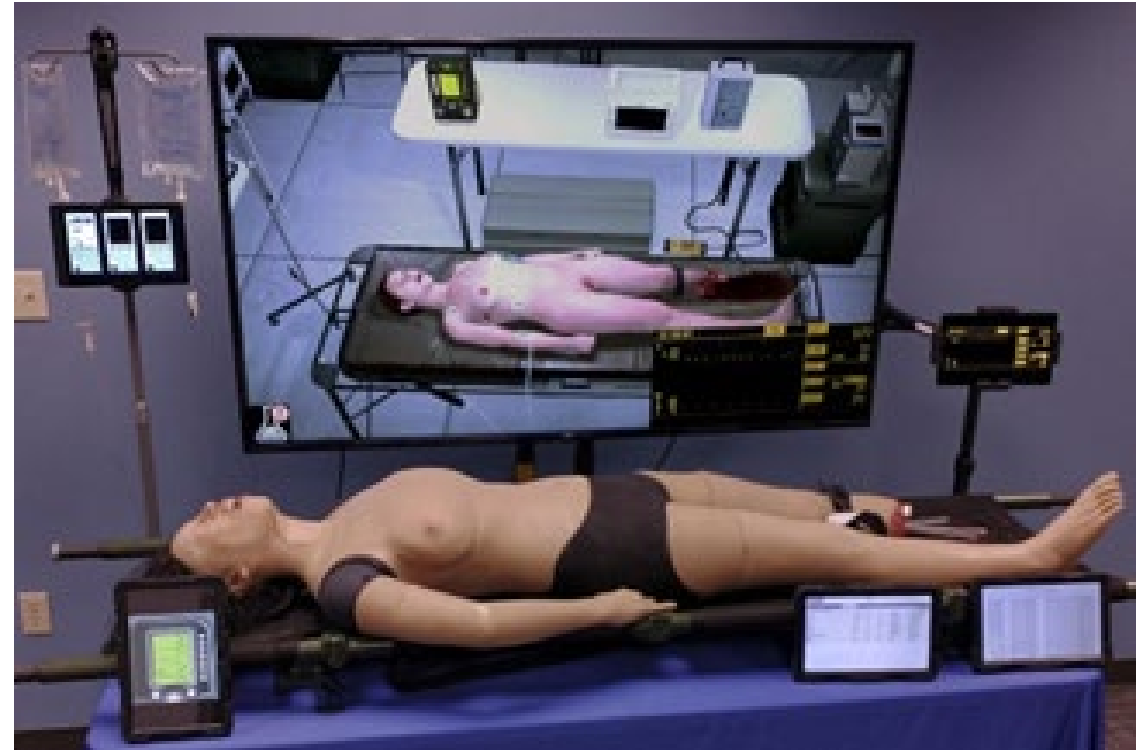


Interoperability Technologies

- Vision-based Intelligent Systems Used for Assessment and Learning (VISUAL)
 - Applies Computer Vision and Machine Learning
 - Evaluates medical performance
 - Uses open standards and open-source data
 - Requires lots of Data!
- Multi Modal Medical Training System (M3TS)
 - Uses a studio with a Mixed Reality Headset
 - Integrates manikin sensors and physiology system
 - Research environment



- Modular Female Small Business Innovative Research Cohort
 - Most recent attempt at promoting interoperability in industry
 - Utilizes HLA and JETS and a revised versions of MoHSES
 - Combines manikin and virtual patient
 - Creates after-action review



Conclusions and Recommendations

- Simulation based medical training positively impacts soldier survivability
- The warfighter landscape is constantly changing, creating different medical training challenges
- Medical simulation Programs of Record are necessary
- R&D is necessary to address emerging training gaps and needs

DOTMLPF

Doctrine: align with established healthcare practices and clinical standards

Organization: integration into healthcare system

Training: create training programs that apply effective medical simulation technologies

Material: assess and evaluate existing simulation technologies

Leadership and Education: cultivate support and advocacy; impact on holistic warfighter outcomes

Personnel: address staffing needs for training

Facilities: optimize physical spaces and explore field capabilities

Conclusions and Recommendations Continued

- Progress is being made
 - Proposed Army DOTMLPF package is gaining support
 - Beginning to see a unified need for standards and true interoperability
 - Standardization of training experiences with Deployed Medicine
 - Emerging formal requirements

- Takeaways
 - Need for interoperability to enhance training simulations
 - Lack of official requirements has stunted progress and adoption
 - Many of the technologies already exist, at least as a prototype!
 - Future research on standardizing of expertise grading and performance measures