The Quadruple Aim: Working Together, Achieving Success
Colonel Deborah N. Burgess, MD, FACP
26 January 2011
Air Force Medical Modeling and Simulation: Bringing Virtual Reality to Reality

Headquarters, Air Education & Training Command, Medical Modernization Division, Randolph AFB, TX, 78150

Presented at the 2011 Military Health System Conference, January 24-27, National Harbor, Maryland
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Overview

- Program Review
- Medical and Simulation Training Limitations
- AFMS Cloud Architecture
- Projects and Resourcing
- DoD MM&ST Consortium
- Strategic Partnerships
- San Antonio Medical Simulation CoE
Program Review

Mission

Integrate Simulation and Emerging Technologies into Education, Training and Sustainment Platforms

Vision

Build a Distributed Simulation Network, Create Centers of Excellence, and Exploit Technological Innovation

Battlefield Trauma, Critical Care Air Transport, In Garrison Care, Patient Safety, Humanitarian Missions, CBRN, Disaster, Homeland Defense and Pandemic Response

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Targeted Training Areas

- Combat Casualty Care
- Critical Care Air Transport/Aeromedical Evacuation
- Patient Safety & Team Training
- Currency, Competency, Sustainment
- Graduate Medical Education
- Nurse and Allied Health
- Natural Disaster & Homeland Security
- Pandemic Response
Preventable medical errors among the leading causes of death in the United States

November 1999
INSTITUTE OF MEDICINE
Shaping the Future for Health

TO ERR IS HUMAN:
BUILDING A SAFER HEALTH SYSTEM
Recommendation 8.1:
“Patient safety programs should...establish interdisciplinary team training programs for providers that incorporate proven methods of team training, such as simulation.”

March 2001
INSTITUTE OF MEDICINE
Shaping the Future for Health

CROSSING THE QUALITY CHASM:
A NEW HEALTH SYSTEM FOR THE 21ST CENTURY

“Faced with such rapid changes, the nation’s health care delivery system has fallen far short in its ability to translate knowledge into practice and to apply new technology safely and appropriately”
• 13.5% Medicare inpatients have at least 1 unexpected adverse event
  • 1.6M harmed per year
  • 180,000 fatalities per year

• 44% “clearly or likely preventable”
  • 707,000 harmed per year
  • 79,000 fatalities per year

Over $4 billion added to Medicare health care cost!
One Decade Later…

A July Spike in Fatal Medication Errors: A Possible Effect of New Medical Residents

David P. Phillips, PhD¹ and Gwendolyn E. C. Barker, BA²

¹Department of Sociology, University of California at San Diego, La Jolla, CA, USA; ²School of Public Health, University of California at Los Angeles, Los Angeles, CA, USA.

• 10% increase inpatient deaths from medication errors in counties with teaching hospitals

• Death rate NOT decreased despite patient safety concerns and decrease in resident work hours (cut in 2003)

Surgical Workload  
(Comparison to US Trauma Center*)

US Level One Trauma Center
- ~2000-7500 admission/year
- <30% penetrating trauma
- High velocity GSW – rare
- Blast injury – rare
- <10% trauma pts need surgery
- Most pts need one procedure/one surgeon
- Multiple casualty event – rare
- Trauma – nominal workload

332 EMDG/AFTH Balad
- ~8000 admissions/year
- >90% penetrating trauma
- High velocity GSW – rule
- Blast injury – very common
- >80% trauma pts need surgery
- Majority pts require multiple procedures and specialists
- Mass casualty event – common
- Trauma – majority of workload

* May 2007

US trauma care unlike battlefield trauma. Medics must combine hands-on with simulation training to achieve and maintain currency and competency.

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“On-The-Job-Training” Not An Option
Central Program Office

- Program established Jan 2008
- Developed/executed CONOPS, strategic plan
- ID requirements, develop standard curricula
- Manage resources: Staff, equipment, support
- New technology development
- Program for sustainment
Central Program Office

- Assets $59.3M, 48.5 FTEs 80 sites worldwide*
- “DoD Center of Excellence” by the ASD/HA
- Lead Service, DoD MM&S Training Consortium
- Lead Service, Joint Technology Coordinating Group-1 Modeling & Simulation subgroup
- USAF SG designated SPO vs MEFPAK for medical simulation E&T

*Current Jan 2011
Facilities grouped into 4-tiered system based on training requirements and simulation capability

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TIER 1:</strong> Centers of Excellence</td>
<td>Curriculum and scenario development, Mentor/train Tier 2 sites, qualified instructors, full-time simulation staff, training GME/RSV/Phase II/Annual/Critical Care/Formal Courses</td>
</tr>
<tr>
<td><strong>TIER 2:</strong> Core Simulation Programs</td>
<td>Execute training and disseminate curriculum/scenarios to Tier 3 sites; Mentor Tier 3 sites, qualified instructors and part-time support staff, training GME/RSV/Phase II/Annual/etc</td>
</tr>
<tr>
<td><strong>TIER 3:</strong> Regional Simulation Programs</td>
<td>Execute simulation training for assigned staff, additional duty simulation staff, training RSV/Annual</td>
</tr>
<tr>
<td><strong>TIER 4:</strong> Program Initiation or Drawdown</td>
<td>Execute RSV, Life Support Training as needed; utilize local hospitals or the VA to support training</td>
</tr>
</tbody>
</table>
Tier I Site Selections

- Wilford Hall *
- Keesler *
- Travis *
- C-STARS Saint Louis
- C-STARS Baltimore
- C-STARS Cincinnati
- USAFSAM - EMEDS *
- Lakenheath UK
- National Capitol Area Simulation Center (USUHS)
- Defense Medical Readiness Training Institute (DMRTI)

* Simulation Operator Course

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Simulation Training Network

Central Program Office

Tier 1
- Students

Tier 2
- Knowledge Sharing
- Standardized Curriculum and Scenarios

Tier 3

Dynamic Network for information Sharing

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Aligning Currency & Training

- In the last 10 years, over 50% of 522 U.S. airline accident fatalities linked to simulation training errors

- “Far easier than in the real world”

- Poor training = catastrophic mistakes

- Simulation is only as good as the data, knowledge and expertise used to train
Medical Training Limitations

- Curricula and training materials not standardized
- Quality variable and inconsistent in/out MTF
  - # patients, surgical cases, staff experience and availability
- Lack validation of skill acquisition, performance
  - Metrics not established, tracked or archived
- Measures of quality and competency flawed?
  - Exams, # cases, errors, complications, malpractice
- No enterprise IT architecture or interoperability
  - Multiple info sources, servers, databases, passwords
  - Difficult to access/unknown, local servers, no mobile app
Simulation Training Limitations

- Lack uniform use of standard tools
- Quality variable - Instructor SME, know simulation?
- Not formally integrated into curriculum
- Poor for surgery, invasive procedures, live tissue
- High student-instructor ratio
  - Limits individual instruction and # didactic sessions
- Low throughput
  - Set-up/breakdown, space availability
- Feedback inconsistent (verbal vs taped)
- Performance metrics not measured or tracked
Health Care Innovation Surge

- Current health care system is unsustainable
- Advances in treating disease and trauma
- Technology innovation has changed how we live
- Little application to improve health system efficiency
- Rising health costs push responsibility onto patients
- New generation of computer-savvy doctors/patients
- Ubiquity of high-speed Internet, mobile devices
- Influx of interest from technology entrepreneurs
- DoD and the Federal Government forces for change

GE and Intel team up to develop Telehealth gadgets for chronic disease management, independent living, and assistive technologies
The Future Airman

Today’s Cyber Teenager = Tomorrow’s Airman

Digital Natives
Young vs Old: Statistical difference in use of technology

- Strategy for E+T technology
- Knowledge, attitudes, views
  - Legacy: PCs, cell-phones, e-mail
  - Newer: virtual worlds, gaming
- 557 participants in two categories
  - Age: Young (18-21) 286, Old (22+) 271
  - Excluded (40+)
- 93% - view of bases online beneficial
- 60% - virtual operational exercises online enhance readiness
- 58% - avatars could be effective mentors
- 65% - online gaming provides encouragement to join military

* Keesler AFB June 2008
AFMS “Cloud” Architecture

AIR FORCE MEDICAL SERVICE
Overarching Strategy for Enterprise Technology Service Delivery

AFMMST PORTAL
Virtual Iraq & Afghanistan
Cybrary
medical modeling & simulation

1. AFMMST PORTAL
2. Virtual Iraq & Afghanistan
3. Medical Learning Management System
4. Medical Gaming
5. Live Tissue Replacement
6. Haptics

Distributed Human Simulation Patient

Medical Modeling & Simulation
Cloud Computing: Software as a Service (SAAS)

- SAAS applications managed from a central server vs on site
- Enables remote access to applications via a web browser
- Eliminates the need to download patches and upgrades
- “Turn-key” access to software and services
- Multiple users access the same app (multiplayer gaming, mobile)
- Affordable, pay-as-you-go, à la carte menu of software
- Eliminates IT infrastructure and software sustainment costs
- Reduces the number of data centers, IT systems, contractors
- Better IT application performance
- Alternative to investing in hardware

Focus shifts from managing IT infrastructure to strategic projects
DoD and Federal Government Technology Alignment

- Cloud computing a new business model for DoD and federal government
- Access to emerging technology and high value data
- Cost savings and greater efficiency
**AFMMST Portal 360°**

The Air Force Medical Modeling & Simulation Training Portal

**Resources**
- Home
- Features
- Documentation
- Media
- Profesional

**AFMMST Info**
- Press Releases
- Requirements Update
- Leadership
- Learning Center Virtual Tour
- AFMMST Metrics
- Media Center
- Army Medical

**Strategic Partnerships**
- CSC-A, CSC-N, USUHS
- Army RDECOM/STTC
- Air Force (Line/AETC)
- UCF Medical School
- Texas A&M (Pulse)
- TATRC, MHS, OASD/HA, VA
- OSD/DDR&E
- PEO-STR
- METC
- AMEDD C & S MS/MSTC/BCTC
- USMC TECOM

**Project Integrations**
- Medical Training via Gaming Simulation
- Virtual Hospitals
- Virtual Sick-Call Training
- Haptics Technology
- LMS Integration
- Reports/Transcripts
- Web-Telehealth SimTool
- Medical Cybrary (docs/blogs, DBs)

**VR Medical Training Online**
- Web-based Virtual Reality Medical Training Portal for AFMS
- AFMS CBTs Online
- AFSC Specific Training
- Online Communities
- CAC Enabled
- Mobile Device Ready
- Industry & DoD Standards

**Cloud Computing Strategy**
- DoD Hosting Center
- Hosted Microsoft SharePoint 2010
- Network Security
- Managed Bandwidth
- IA Compliance
- Enterprise Storage Solution (SAN)
- Live Chat Support
- Virtualization

**Requirements Process**
- Funding Allocated
- Staffing Acquisitions
- Strategy Development
- Partner Evaluations

**Funding Allocated**
- Infrastructure
- AFMMST Portal Devt
- Content Mgmt
- Hardware Setup

**IA Process**
- Development
- Project Integrations
- Online CBTs

**Strategy Development**
- Virtual Hospitals
- Medical Gaming
- Web-Telehealth
- Video Library
- Cybrary, Blogs

**Partner Evaluations**
- Achieve IOC
- Continued Development
- Ongoing Sustainment

**4th Quarter FY 2010**
- Requirements Process
- Funding Allocated
- Staffing Acquisitions
- Strategy Development
- Partner Evaluations

**1st Quarter FY 2011**
- Infrastructure
- AFMMST Portal Devt
- Content Mgmt
- Hardware Setup

**2nd Quarter FY 2011**
- Development
- IA Process
- Project Integrations
- Online CBTs

**3rd Quarter FY 2011**
- Virtual Hospitals
- Medical Gaming
- Web-Telehealth
- Video Library
- Cybrary, Blogs

**4th Quarter FY 2011**
- Achieve IOC
- Continued Development
- Ongoing Sustainment
Open the slide where you want to place the video.

On the INSERT menu, point to MOVIES AND SOUNDS and then click MOVIE FROM FILE. Locate the file and click to add it to your slide. Ensure that the video is placed correctly.

To test the video, go to SLIDE SHOW > VIEW SHOW and locate to the slide where the video is placed. Click on the video.
New Technology via AFMS Cloud

- AFSC and UTC specific training
- Virtual Hospital/EMEDS/C-17
- Virtual Medical Campus
  - Staff and Patient Education
- Medical Gaming – single/multi
- Cybrary, Professional Blog, CoPs
- Mobile application ready
- Web-based Education & Training System
- Defense Connect Online
- Center for Excellence in Multimedia
Knowledge Management Strategy

- Knowledge Management
  - Overarching Framework
  - Data tracking (performance metrics)
  - Enables archiving/historical documentation
  - Facilitates knowledge sharing

- Continuous Learning
  - Recruitment through retirement
  - Integration of learning and ops
  - Training, education, experiential learning

- Precision Learning
  - Persistent environment (24/7 access)
  - Tailored to individual styles and needs

Standard framework that is knowledge-centric not network-centric
Training by environment across ARFORGEN
Current Program

Image courtesy of Dorothy E Buckholdt Director, Advanced Distributed Learning USAF School of Aerospace Medicine
210-536-4671 Dorothy.Buckholdt@brooks.af.mil
USUHS and AFMS Research & Development Partnership

- USUHS conducts USAF medical simulation training

- USAF R+D Asset
  - PA Catheter Simulator
  - VR Cricothyroidotomy Simulator
  - VR Head Trauma Trainer
  - Wide Area Virtual Environment
The Wide Area Virtual Environment

Alan Liu
Mark Bowyer
Gilbert Muniz
New Technology Development

- **Congressional Projects**
  - Natural Disaster Response Gaming Simulation ($3.44M)
  - Military Trauma Training ($708K) CSTARS Baltimore/UMMC
  - Spec Force Med Training – PJ/Combat Control Team ($2.9M)

- **Small Business Innovation Research ($300K)**
  - Medical Gaming +/- haptics - virtual surgery/invasive procedures
  - Virtual Environments - Hospital/EMEDS/CCATT
  - Synthetic Tissue to augment/replace live tissue – 1st in DoD

- **HQ AETC Advanced Tech Learning Demo ($400K)**
  - 4N0X1 Phase 1 METC Training Gaming Simulations

- **Defense Medical Research & Development (ROI)**
  - Tri Service Medical Simulation & Trng Curriculum Development and Validation Research ($5.5M) AF SGR is PI
<table>
<thead>
<tr>
<th>Requirement</th>
<th>In-Place?</th>
<th>Initial Funding In-Place?</th>
<th>Partnership</th>
<th>ETA</th>
<th>AFMMST Portal &amp; Cloud Strategy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Modeling and Simulation Training Portal (AFMMST Portal)</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR USDA</td>
<td>July 2011</td>
<td>Yes</td>
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<tr>
<td>Virtual Reality Medical Gaming</td>
<td>Yes</td>
<td>Yes</td>
<td>RDECOM Texas A&amp;M Univ</td>
<td>Mar 2011</td>
<td>Yes</td>
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<tr>
<td>Cloud Computing Hosting Partners</td>
<td>Yes</td>
<td>Yes</td>
<td>UCF RDECOM</td>
<td>Dec 2010</td>
<td>Yes</td>
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<tr>
<td>AFSC Based Medical Games</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR RDECOM Mountain Top Tech</td>
<td>Jun 2011</td>
<td>Yes</td>
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<tr>
<td>Medical Scenarios VR Based Learning</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SG RDECOM</td>
<td>Apr 2011</td>
<td>Yes</td>
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<tr>
<td>LMS Integration</td>
<td>Yes</td>
<td>No</td>
<td>AETC</td>
<td>TBD</td>
<td>Yes</td>
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<tr>
<td>AFMS Virtual World</td>
<td>Yes</td>
<td>Yes</td>
<td>RDECOM AETC</td>
<td>Jun 2011</td>
<td>Yes</td>
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<tr>
<td>Online TeleHealth VR Tools</td>
<td>Yes</td>
<td>Yes</td>
<td>SPAWAR</td>
<td>May 2011</td>
<td>Yes</td>
</tr>
<tr>
<td>Online Cybrary (Virtual Medical Research &amp; Learning Lab)</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR DKO</td>
<td>Apr 2011</td>
<td>Yes</td>
</tr>
<tr>
<td>AF Medical SME Online Communities</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR DKO</td>
<td>Jun 2011</td>
<td>Yes</td>
</tr>
<tr>
<td>VR Training of Critical Medical Apps (AHLTA, TMIP, etc)</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR</td>
<td>Mar 2011</td>
<td>Yes</td>
</tr>
<tr>
<td>Status of Emerging Technologies (Haptics, Live Tissue Replacement, Virtual Islands, etc)</td>
<td>Yes</td>
<td>Yes</td>
<td>AETC/SGR</td>
<td>Dec 2010</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Bringing “Virtual Reality” to “Reality”

Reach the Summit by October 2012

**High Risk / Least Effective Strategy**
- Medical Gaming Developed for Each Service Branch
- Hardware & VR Games Installed on Base LAN
- Game Enhancements / Updates Mailed to Customers
- Lengthy DIACAP Process Per Game
- From Requirements to Time to Deploy is Very Long

**Moderate Risk / Limited Success Strategy**
- Stand-Alone PCs & VR Med Games at MTFs
- Too Many Users vs. Limited Computers
- Expensive, Not Practical, Accessibility Issues
- Local Hardware/Software Support Required

**Minimum Risk / High Probability of Success**
- Tri-Service Med VR Games Hosted (Cloud)
- Centralized Mgmt, Updates, DIACAP, Enhancement
- Rapid Availability of Med Training via Web
- No Local Hardware/Software to Maintain/Refresh
- Services Leverage from Each Other
- Centralized Metrics, Feed to TTMS, LMS etc
- Subscription “A La Carte” Service to AFMS
- Lower Costs, Rapid Deployment, Joint Med Approach

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<table>
<thead>
<tr>
<th>Operational Milestones and Partnerships</th>
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<tbody>
<tr>
<td><strong>Technical Related</strong></td>
</tr>
<tr>
<td>AFMMST Portal framework development</td>
</tr>
<tr>
<td>Portal Cloud Computing Strategy Set</td>
</tr>
<tr>
<td>Portal Cloud Computing Infrastructure Partner Selection</td>
</tr>
<tr>
<td>Funding for Portal Cloud Hosting and Sustainment</td>
</tr>
<tr>
<td>IT Staff Selections Complete</td>
</tr>
<tr>
<td>MIPR funding to USDA Complete</td>
</tr>
<tr>
<td>IT Equipment / Developer Computers Purchased</td>
</tr>
<tr>
<td>RDECOM business model change to AF Cloud Architecture</td>
</tr>
<tr>
<td>Web-Based Medical Gaming as a Business Model (SAAS)</td>
</tr>
<tr>
<td>AF Medical SME Online Communities</td>
</tr>
<tr>
<td>TC3, MSTC, CBTCS, Pulse to be Web-Based</td>
</tr>
<tr>
<td>Migration from CD Based Games to Cloud/MilGaming</td>
</tr>
<tr>
<td>AFMS Virtual World Strategy Set (User Entry Point)</td>
</tr>
<tr>
<td>IT Partnerships with UCF IST, AFAMS, CEMM and ECS</td>
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<tr>
<td>CEMM Integration to AFMMST Portal (Virtual Library)</td>
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</table>
DoD Medical Modeling & Simulation Training Consortium

- Develop Joint requirements and standardized curricula
- Create DoD medical training platforms, exercises
- DoD research and multicenter validation studies
- Build “The DoD Medical Cloud”
- Joint technology development
  - AFMM&S CIO imbedded with Army RDECOM/STTC
  - RDECOM changed business model to adopt the AF cloud strategy
  - ECS Corpsman trauma medical game adapted to AF req’s/scenarios
  - Texas A&M and CSC-N– Pulse
  - NCA Sim Center USUHS Wide Area Virtual Environment– to AFMS
DoD Medical Modeling & Simulation Training Consortium

### DoD MM&S Partnerships
- AFSOC A5Z (Pararescue)
- AMEDD C+S EMS/MSTC
- METC
- CSC-A, CSC-N
- USMC TECOM
- OASD(HA)TMA
- OSD/DDR&E – ULAMETJAT
  - JTCG-1, JPC-1 (research)
- NCA Medical Simulation Center
- USUHS
- BAMC

### Other Strategic Partnerships
- CEMM
- AMEDD C+S BCTC – Battle Combat Training Center
- RDECOM/STTC
- University of Central Florida
- PEOSTRI
- DMRTI
- TATRC
- HQ AETC CC
- American College of Surgeons
- USC Institute for Creative Technologies
- UC Davis
San Antonio Medical Simulation Center of Excellence

- DoD, Academia, Federal, State, Industry partners
- Assessed Joint training, space, staff req’s
- Location?
  - 27.5K sq ft space close to Ft Sam Houston
  - New MILCON vs existing building refurbishment
- Resourcing and Sustainment
  - Budget, manpower, equipment
  - How do we insert, update new technology?
Strategic Roadmap

Theme: CENTER DEVELOPMENT
Phase: 1. Simulation Centers

Doctrine
- Service

Organization
- Primary Location/Med Facility

Training
- Standardized Joint
- Standardized Service

Materiel
- Materiel Solutions

Leadership
- Service

Personnel
- Service

Facilities
- Tier 1 Sites
- Tier 2 & Tier 3 Sites

Service Synergy
Phase: 2. AFMS Distributed Simulation Network

Doctrine
- Joint integration for training/war games

Organization
- Consolidation

Training
- Standardized Joint Integration Updates
- Standardized Service Synch Updates

Materiel
- Materiel Solutions
- Innovation Solutions

Leadership
- Joint

Personnel
- Service

Facilities
- Distributed Human Patient Simulation Network

Joint Integration
Phase: 3. Educate/Train Med War Games

Doctrine
- Service

Organization
- Integration of training sites

Training
- Joint Integration Updates

Materiel
- Materiel Solutions

Leadership
- Joint

Personnel
- Service

Facilities
- Joint Simulation Centers: NCR/SAMMC

Timeline:
- Jan 2008
- Jan 2009
- Jan 2010
- Jan 2011

2011 MHS Conference
AFMMS Central Program Office

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Ms Shae Peters – Deputy Director
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