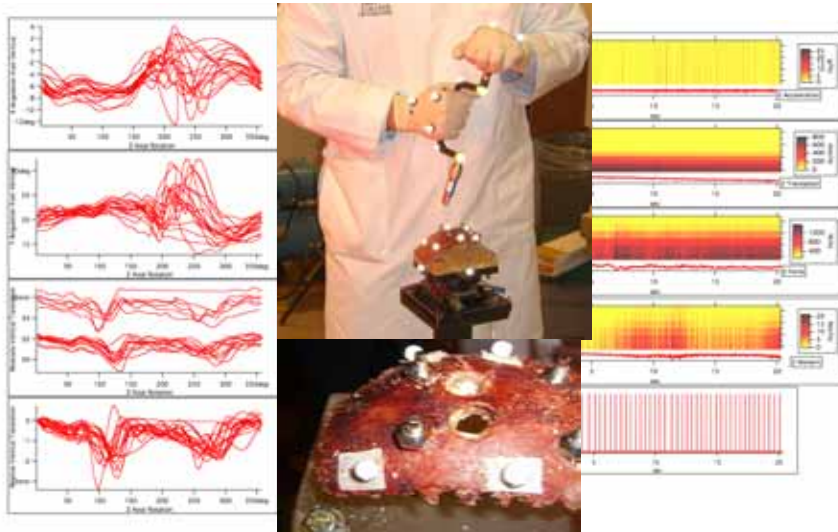




# Intracranial Hematoma / Burr Hole Flap Simulator

Dwight Meglan PhD, SimQuest EDMS: 2817



**Objective:** Quickly provide surgeons without neurosurgical experience with the knowledge and physical skills to place a cranial burrhole for removing an intracranial hematoma

**Deliverables:** A physics-based simulator that provides an accurate visual and haptic experience of the burrhole creation process that can be used in remote, standalone, just-in-time training

**Approach:** Assess knowledge & skills required. Measure actual forces/moments in placing burrholes. Develop physics-based simulation of drilling process that mimics actual forces/moments. Implement drilling simulation in hands-on simulator.

### Schedule & Cost

MILESTONES	FY06	FY07	FY08
Characterize drilling loads		██████████	
Model drilling & refine		██████████	
Integrate haptics device		██████████	
Create head model & visuals		██████████	
Implement scenario & metrics		██████████	
Validate system			██████████
<b>Total \$</b> <b>850K</b>			
<b>SBIR/II</b>	100K	387K	363K

**Military Relevance:** Simulator will allow skilled surgeons without neurosurgery experience to learn in the field to perform simple life saving neurosurgical procedures

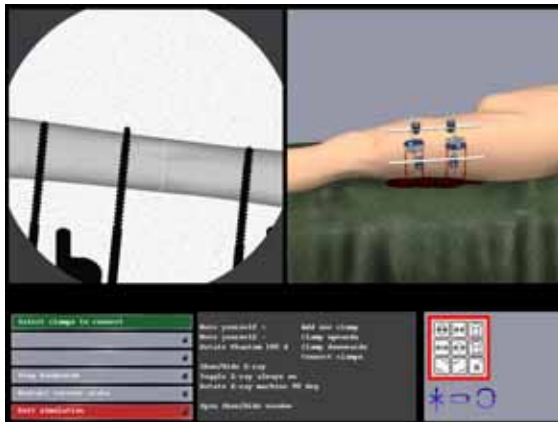
**Endorsements:**  
Col. Jim Ecklund, WRAMC, Chief of Neurosurgery  
Dr. Tom Genarelli, MCW, Chief of Neurosurgery

**Transition Opportunities / Commercialization Plan:**  
Accurate, experiential bone drilling simulation has application in general orthopedics as well as neurosurgery



# Fractured Femur Simulator

Bruce D. Anderson, Ph.D.: Simulation Inc. EDMS: 2638



**Objective:** Develop a validated simulation and curriculum for the diagnosis and care of fractured femurs and other lower extremity trauma. Specifically focused on external fixation techniques relevant for combat casualty care.

**Deliverables:** A demonstration of a prototype system, validation studies and a written report.

**Approach:** Develop a hybrid simulator that uses an advanced physical model integrated with Virtual Reality (VR) technology to yield a realistic training environment.

## Schedule & Cost

MILESTONES	FY04	FY05	FY06	FY07
Phase I Feasibility	█			
Physical Model Development		██████████		
Tissue Def & Injury Simulation			██████	
External Fixator System Sim.			██████	
Metrics & Scoring			██████	
Didactic Curriculum			██████	
Validation Studies				██████
<b>Total \$</b> <b>849.6K</b>				
<b>SBIR/II</b>	100K	240K	282K	227K

**Military Relevance:** The use of body armor has decreased mortality, increasing the number of military personnel who suffer traumatic limb injuries. Improving care in the field through improved training can decrease the amputation rate.

**Endorsements:** Chosen by Abbott Spine as the platform of choice for VR simulation of their MIS Spine surgery procedures for marketing and training.

**Transition Opportunities / Commercialization Plan:** Lackland AFB has requested a quote and information. Contracts for Commercial Development with Abbott Spine and Arthrex (pending). Marketing of value added training for device manufacturers.



# A Unified Surgical Simulation Platform for Medical Readiness Training



Alan Liu, NCAMSC EDMS: 2809

## A Unified Surgical Simulation Platform for Medical Readiness Training

**Objective:** To investigate the feasibility of developing multiple surgical simulators on a common hardware platform.

**Deliverables:** A pulmonary artery catheterization simulator as a proof of concept

**Approach:** Develop proof-of-concept system on existing hardware platform.

### Schedule & Cost

MILESTONES	FY05	FY06	FY07	FY08
Hardware Integration	■			
API Development		■		
PAC Sim Development			■	
Case Content Development				■
Assessment and Review				■
Clinical Content Development				■
Testing and Feedback				■
<b>Total \$</b>				

**Military Relevance:** Military healthcare system maintains competency in critical skills; unified platform reduces cost of deploying simulators

**Endorsements:** Subject Matter Expert - COL Mark Bowyer, former Head of Trauma, Balad, Iraq.

**Transition Opportunities / Commercialization Plan:** Both civilian and military requirement for this procedure.



# Combat Medic

Mark Wiederhold, VRMC EDMS: 2878



**Objective:** Develop test and validate a low cost interactive simulation (video game) to augment Army Combat Medic Training

**Deliverables:** Combat Medic Simulation Trainer

**Approach:** Using a commercially available video game engine (Quest 3D), develop an adjunct to the 68W Combat Medic Advanced Skills Training Curriculum (CMAS)

**Schedule & Cost**

MILESTONES	1	2	3	4	5	6	7	8	9	10	11	12
Prototype	█	█										
Refinement				█	█	█	█					
Protocols								█				
Training								█				
Testing									█	█		
Analysis											█	
Results												█
<b>Total \$</b>												

**Military Relevance:** Simulates the stages of Tactical Combat Casualty Care (TCCC); Care Under Fire; Tactical Field Care; and Combat Casualty Evacuation Care

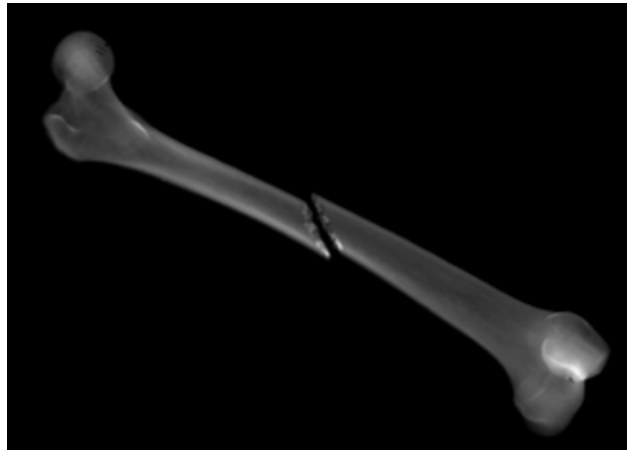
**Endorsements:** Selected by the Surgeon General (Army) for Deployment in the Army's Recruitment Van.

**Transition Opportunities / Commercialization Plan:** Strategic partners include Ft. Sam Houston, Ft. Rucker, Ft. Gordon, National Capital Area Medical Simulation Center, United States Army Office of the Surgeon General and Marine Corps Camp Pendelton and Quantico Battle Lab



# Fractured Femur Simulator

Karl Reinig, Touch of Life Technologies EDMS: 2639



**Objective:** Produce an adaptable virtual environment for training diagnosis and treatment of thigh trauma, in particular, femur fractures

**Deliverables:** An adaptable prototype VR-based simulator with the ability to train diagnosis and treatment of thigh trauma significantly more effectively than current methods; A web-based version for distribution around the world

**Approach:** Combine 3-D graphics, haptics, and models from the Visible Human to produce virtual patients; Use Finite Element Modeling (FEM) to inflict trauma on the virtual patients; Add a Mentor program to guide, critique, and score the student

## Schedule & Cost

MILESTONES	FY05	FY06	FY07	FY08
Create Virtual Trauma	[Progress bar]			
Develop Clinical Imaging	[Progress bar]			
Develop Curriculum	[Progress bar]			
Develop Cross Planning Sim	[Progress bar]			
Develop Exte3rjnal Fix Sim	[Progress bar]			
Validation	[Progress bar]			
Inclusion in CPS	[Progress bar]			
<b>Total \$ 760K</b>	<b>9.9K</b>	<b>375K</b>	<b>375K</b>	

**SBIR/II**

**Military Relevance:** Better training directly addresses the desire for improved medical care for soldiers sustaining extremity injuries; The Mentor, without haptics and stereo display, can be used by anyone having computer access. Lessons can be modified over the web, providing real-time reaction to evolving training needs.

**Endorsements:** The Academy of Orthopaedic Surgeons is collaborating with ToLTech on both the Fractured Femur Simulator and the Compartment Syndrome Simulator and expects to endorse the combined validated product

**Transition Opportunities:** The Simulator will be part of an extremities trauma simulator and be displayed on a Common Platform Simulator (CPS). The CPS will deliver training for regional anesthesia, arthrocentesis, general surgery skills, and ophthalmic surgery as well as extremities trauma.



# Ultra-High Resolution Display for Army Medicine (UHRDARM)

Ihor Wacyk, eMagin Corporation EDMS: 3202



**Objective:** Support TATRC mission for improving medical training through highly realistic Virtual Reality systems by developing an ultra-high resolution affordable, 3-D HMD.

**Deliverables:** Micro splay with ultra-high resolution to 1920 x 1200 color pixels; Optics with wide field of view between 60 and 80 degrees; HMD interface and control electronics with <2W total power consumption; Ergonomic (lightweight & balanced) head mounting mechanism weighing <750gms

**Approach:** Small-pixel development based on Active Matrix OLED technology; Build SXGA display as proof of concept for low-power architecture & pixel driver; Multi-year program (4 year) to develop full WUXGA HMD

## Schedule & Cost

MILESTONES	FY06	FY07	FY08	FY09
Develop SXGA Concept	█	█		
Build full WUXGA microdisplay			█	█
Optics Design & Development		█	█	
Interface & Control Electronics			█	
Mechanical & HMD Mechanism				█
<b>Total \$</b>				
<b>CSI - 07</b>	1.3M	1.6M	(6.0M)	(2.5M)

## Military Relevance:

Military and civilian medicine rely increasingly on advanced simulation technology to demonstrate procedures and to train medics and physicians in traditional and innovative procedures. The high resolution technology being developed by eMagin will provide capability for an OLED HMD that is compact, lightweight, and power-efficient

**Endorsements:** US Army Night Vision Labs; Training and Simulation OEMs; Members of the Behavior Health Community; Commercial camera company

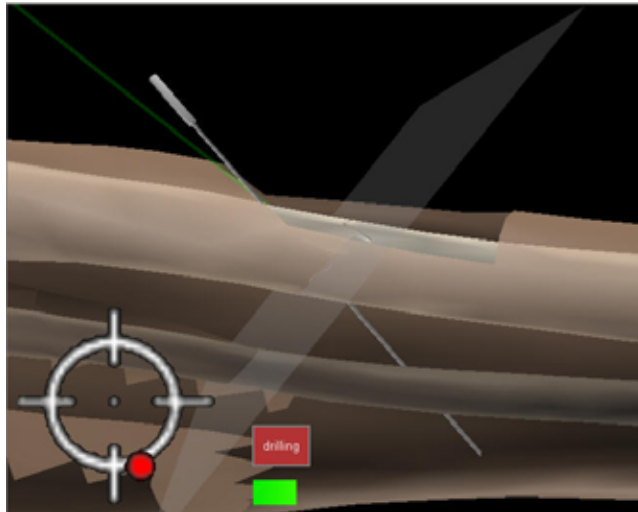
## Transition Opportunities / Commercialization Plan:

Significant market foreseen for SXGA spin-off in military, computer simulation, CAD, games, and entertainment applications.



# Simulation-based Open Surgical Training System

Dwight Meglan PhD, SimQuest EDMS: 3325



**Objective:** Assess the effects of inadequate haptics and feedback augmentations upon transfer of training

**Deliverables:** Software and surgical scenarios that provide a flexible set of tools to evaluate the effect of augmentations in compensating for insufficient haptic devices

**Approach:** Develop software using open source code to minimize replication. Choose surgical tasks that have field utility as well as haptic diversity. Couple these with inexpensive COTS haptics hardware. Implement a limited set of straightforward augmentations. Do a transfer of training assessment.

## Schedule & Cost

MILESTONES	FY05	FY06	FY07
Assess task haptic cues		██████████	
Select enhancements		██████████	
Implement sim infrastructure		██████████	
Implement scenario			██████████
Assessment study			██████████
<b>Total \$ 850K</b>	<b>SBIR/II</b>	120K	365K

**Military Relevance:** If augmentations can compensate for negative transfer of training effects of inadequate haptics, then more cost effective & more deployable simulation-based surgical skills training will be possible.

**Endorsements:**

**Transition Opportunities / Commercialization Plan:** Similar augmentation concepts can be used to build more cost effective commercial surgical trainers



# Injury Creation Science

Mark Wiederhold, VRMC EDMS: 3304



**Objective:** Validate the effectiveness of life-like human tissue to improve trauma training skills while achieving stress inoculation of troops

**Deliverables:** Trauma Training Kits

**Approach:** Test and evaluate prototypes

## Schedule & Cost

MILESTONES	1	2	3	4	5	6	7	8	9	10	11	12
Literature Search												
Injury Identification												
Build Test Version												
Conduct Testing												
Analysis												
Reporting												
<b>Total \$ 850K</b>	CSI – '07											

**Military Relevance:** Advanced medical training tools

**Endorsements:** U.S. Army, Shands Jacksonville

**Transition Opportunities / Commercialization Plan:**  
Able to transition to civilian training applications (EMT)



# Medical Simulation Training for CBRNE

Laura Kusumoto, Forterra Systems, Inc. EDMS: 2705



**Phase II Objective:** Extend a massively multiplayer online simulation (MMOS) by integrating 3<sup>rd</sup> party physiology models in an open architecture. Develop and evaluate curriculum for practice of in-hospital response to mass casualty incidents.

**Deliverables:**

- Plug-in for Physiology Models for MMOS Platform
- Hospital Emergency Department Virtual Environment
- In-Hospital Response Curriculum
- Formative Evaluation with In-Hospital First Responders

**Approach:**

- Two 3<sup>rd</sup> Party models and 20 patient cases: Dozens of patients with different types of injuries simulated at once
- Triage, Immediate and Delayed Areas run simultaneously

**Schedule & Cost**

MILESTONES	FY06	FY07	FY08
Research with SMEs	█		
Develop Virtual Environment		█	
Develop Scenario & Curriculum		█	
Develop Software		█	
Physiology Model Programs		█	
Eval at Stanford Hospital			█
Eval at San Mateo County MC			█
<b>Total \$ 730K</b>			
<b>SBIR/II</b>	420K	310K	

**Military Relevance:**

- CBRNE Distributed Team Training
- Integrating training architecture to support new Theater Combat Casualty Care JORD-Medical C2
- Mass Casualty team training platform for SASO

**Endorsements:**

- Briefings to ASB and Congress-Capitol Hill
- PEOSTRI consideration for technology acquisition
- Adjacent developments at RDECOM and ADL Co-LAB (SCORM)

**Transition Opportunities / Commercialization Plan:**

- Army CPP Program-Medical Mission Rehearsal
- Medical Education
- A Training and Therapy Environment



# Computer Simulated Standardized Patients for Training Early Detection of CBRNE Events



Dale Olsen, PhD, SIMmersion LLC EDMS: 2707



**Objective:** To develop a **Virtual Standardized Patient (SP)** for training, and evaluate its effectiveness for identifying indicators of chemical, biological, radiological, nuclear, and high explosive (**CBRNE**) events.

**Deliverables:** A simulation in which Learners interact with a Virtual Standardized Patient and are evaluated on their ability to **perform** efficient and effective **exams**, **make** differential **diagnoses** of chicken pox, Marburg viral hemorrhagic fever, Rocky Mountain spotted fever, and smallpox and **implement patient management plans**.

**Approach:** Customize existing human simulation technology for CBRNE training, train medical personnel using e-learning and simulation, and evaluate using standardized patients.

## Schedule & Cost

MILESTONES	FY07	FY08
Complete Simulation Script	█	
Develop Audio and Video	█	
Develop E-Learning Content	█	
Deliver Final Simulation	█	
Pilot Research Study	█	
Data Analysis	█	
Full Research Study		█
Commercialization Planning	█	
<b>Total \$ 538K</b>	<b>391K</b>	<b>147K</b>

**SBIR/II**

**Military Relevance:** Simulation content is consistent with the DoD standardized Tri-Service CBRNE Training Program that aims to **prepare medical personnel to appropriately respond to CBRNE events** and supports medical readiness training.

**Endorsements:** Research is not complete.

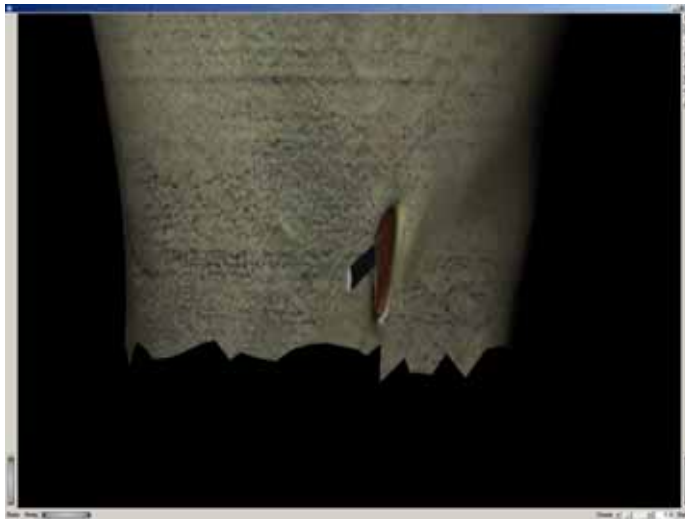
**Transition Opportunities / Commercialization Plan:**

- SIMmersion has briefed **CDC** and there is interest. We are planning other CDC meetings.
- Team with **USUHS** on basic research proposals
- More papers will be **published**.
- We plan to address medical institutions, including military hospitals, federal and state agencies, schools of medicine, medical associations and education companies.



# SOSTS Simulator

Karl Reinig, Touch of Life Technologies EDMS: 2709



**Objective:** Produce an adaptable virtual environment for training general surgical skills. Initial release will focus on gaining surgical access using scalpels, fingers, and retractors.

**Deliverables:** A prototype VR-based simulator that allows students to gain surgical access to an entire virtual patient. The virtual patient will be combined with a virtual Mentor designed to guide, critique, and score the student's performance.

**Approach:** Combine 3-D graphics, haptics, and models from the Visible Human to produce virtual patients; Develop real-time alteration of the virtual patient by scalpels, forceps, fingers, and retractors; Develop an extra-corporal blood model to display the effects of bleeding; Create a virtual assistant to give extra hands to the student; Add a Mentor program

## Schedule & Cost

MILESTONES	FY05	FY06	FY07	FY08
Demo RT Cut Primitives	█			
Develop Ex Corp Blood	█	█		
Develop Scalpel		█	█	
Develop Traction		█		
Develop Mentor	█	█	█	
Develop Curriculum	█	█	█	
Inclusion in CPS				█
<b>Total \$ 848K</b>				
<b>SBIR/II</b>	119K	358K	370K	

**Military Relevance:** Better training directly addresses the need for improved medical care for our Soldiers; the "Mentor", without Haptics and stereo display, can be located at the side of anyone with computer access; all lessons can be modified the web, allowing real-time reaction to evolving training needs

**Endorsements:** None

**Transition Opportunities:** The simulator will be part of an extremities trauma simulator and will be displayed on a Common Platform Simulator (CPS). By the end of 2008, the CPS will deliver training for regional anesthesia, arthrocentesis, extremities trauma and ophthalmic surgery as well as general surgery skills.



# Compartment Syndrome Simulator

Michelle Bagur, Touch of Life Technologies EDMS: 2885



**Objective:** Produce a highly adaptable virtual environment for training diagnosis and treatment of compartment syndrome.

**Deliverables:** An easily adaptable VR-based simulator in which to practice diagnosis and treatment (including fasciotomy) of compartment syndrome of multiple extremities including the leg. A web based version for distribution around the world.

**Approach:** Combine 3-D graphics, haptics, and models from the Visible Human to produce virtual patients; Augment cutting algorithms being developed in SOSTS to add the ability to perform fasciotomies; Add a Mentor program to guide, critique, and score the student

*Schedule & Cost*

MILESTONES	FY06	FY07	FY08
Demonstrate Tech	██████████	██████	
Improve Display	██████		
Develop Var of Morph	██████████		
Create Fasiotomy DVD		██████	
Fasciotomy Sim		██████████	
Develop Curriculum		██████████	
Validation Design		██████	
Validation			██████
Inclusion in CPS			██████
<b>Total \$ 850K</b>			
<b>SBIR/II</b>	119K	364K	366K

**Military Relevance:** Addresses the need to improve medical care for our Soldiers who sustain extremity injuries; The "Mentor" can be located at the side of anyone with computer access; all lessons can be modified the web, allowing Real-time reaction to evolving training needs

**Endorsements:** The Academy of Orthopaedic Surgeons is collaborating with ToLTech on this simulator and on the Fractured Femur Simulator and expects to endorse the combined validated product

**Transition Opportunities:** The simulator will be part of an extremities trauma simulator and will be displayed on a Common Platform Simulator (CPS). By the end of 2008, the CPS will deliver training for regional anesthesia, arthrocentesis, general surgery skills, and ophthalmic surgery a well as extremities trauma. Instructional DVD already in Field



# Simulation-based Planning Tool for Infectious Disease Outbreak, i.e. Pandemic Influenza

Dwight Meglan, PhD, SimQuest, LLC EDMS: 3325



**Objective:** development of capability to practice mitigation strategies at the local medical treatment facility (MTF) level can reduce the disease spread. A simulation-based strategy game that can teach MTF administrators and supervisors the effects on the spread of disease from strategic planning and tactical decisions will allow them to respond more quickly and effectively.

**Deliverables:**  
Conceptual game design and mock-ups

**Approach:**  
PC-based real-time strategy game will evaluate users' ability to recognize early warning signs and track their strategic planning and decision making when presented with actual events.

## Schedule & Cost

MILESTONES	FY07	FY08	FY09
Assess Plans & Strategies	█		
Evaluate Predictive Models	█		
Review Game Engines	█		
Assess Learning Aspects/Metrics	█		
Define Infrastructure	█		
Demonstrate Design Samples	█		
Phase II*		█	
<b>Total \$ 100K</b>	SBIR/I	99.9K	(XXX) (XXX)

**Military Relevance:** Force Protection and military readiness. More soldiers were killed by the flu in 1918 than in World War I in total.

**Endorsements:**

**Transition Opportunities / Commercialization Plan:**  
About 5,800 hospitals in US  
74,000 hospital administrators  
Working with Virtual Heroes to plan next steps

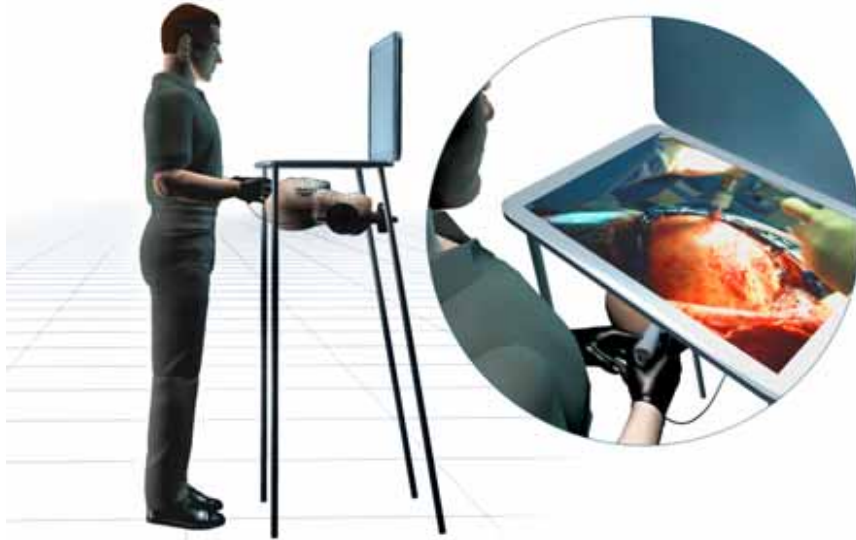




# Intracranial Hematoma/Burr Hole and Trauma Flap Simulator



**Dr. Randy S. Haluck, Verefi Technologies, Inc. EDMS: 2822**



**Objective:** To develop a hybrid haptic workbench with realistic surgical instruments and integrated curriculum for simulation of intracranial burr holes and trauma flap for evacuation of intracranial hematomas following traumatic head injuries

**Deliverables:** 1. Working prototype trainer usable by target training audience; 2. Documents relating to simulator design including course content, hardware development, virtual environment modeling, simulation engine development, SCORM compliance, and validation.

**Approach:** Combination of hybrid haptic workbench with didactic and dexterous skills instruction to yield a trainer for non-neurosurgeons to learn emergent operative management of traumatic intracranial hematomas.

### Schedule & Cost

MILESTONES	FY06	FY07	FY08
Course Content Development		█	
Hardware Development		█	
Virtual Environment Modeling		█	
Simulation Engine Development		█	
SCORM Compliance		█	
Validation			█
Commercialization			█
<b>Total \$ 662K</b>	<b>0</b>	<b>336K</b>	<b>323K</b>

**Military Relevance:** Head injuries are a common consequence of IED. Rapid evacuation of intracranial hematomas may save lives and minimize traumatic brain injuries. Procedures may have to be performed by non-neurosurgeons because neurosurgeons are unavailable at front lines.

**Endorsements:** Assistance from Stryker Corporation and Medtronic in tool development is acknowledged.

**Transition Opportunities / Commercialization Plan:** Working prototype available at end of Phase II and would be refined through product development activities and advance marketing at trade shows. Product launch would occur ~ one year following completion of Phase II.



# Polish PTSD

Brenda Wiederhold, IMI EDMS: 3009



**Objective:** Deliver and train Polish troops to use PTSD treatment system

**Deliverables:** Final Report and Polish PTSD treatment software

**Approach:** Leverage ONR PTSD program and expand effort to NATO members

## Schedule & Cost

MILESTONES	1	2	3	4	5	6	7	8	9	10	11	12
Check Hardware	█											
Obtain buy-in	█											
Assess Feasibility	█											
Video Training		█										
Run Pilot Test			█									
Adjust Protocol			█									
Recruit/Treat Participants				█	█	█	█	█	█	█		
Assess Therapists				█	█	█	█	█	█			
Analyze data										█	█	
Write Report										█	█	
<b>Total \$</b>	<b>FY06 Grant of \$220K</b>											
<b>220K</b>												

**Military Relevance:** Train Polish military health care providers to treat personnel with PTSD

**Endorsements:** Polish Military Institute of Health Service

**Transition Opportunities / Commercialization Plan:** NATO and Polish MOD funding opportunities