



# Virginia Modeling, Analysis and Simulation Center

## *Modeling & Simulation Applications in Bio-Medicine* *Dr. R. Michael Robinson*

1030 University Boulevard  
Suffolk, VA 23435  
June 15, 2010

# APPLIED RESEARCH AREAS

- General BOK/Applied Principles of M&S (**fundamental concepts: theory of simulation, distributed simulation, interoperability, V&V, etc.**)
- General / Social Science (**non-medical life sciences: ecology, climate modeling, oceanography, biochemistry, etc.**)
- Defense/HLS (**interfacing M&S capabilities with C2, M&S OR support, analysis and visualization of military or HLS system problems**)
- Medical & Healthcare (**augmented VR, VOR, VR Rehabilitation, and physical systems modeling, etc.**)
- Business & Supply Chain Modeling / M&S in Eng (**changes in traditional eng disciplines: enterprise decision support, product design, optimization and more**)
- Transportation (**M&S to solve multimodal {road, rail and air} transportation problems – micro/macroscopic travel**)
- Virtual Environments (**domain specific virtual intelligent agents, construction of VE, flexible crowd models, task level planning of agents and immersive simulations**)
- Education & Game-Based Learning – **serious games to train soldiers, workforce and help achieve national STEM objectives.**

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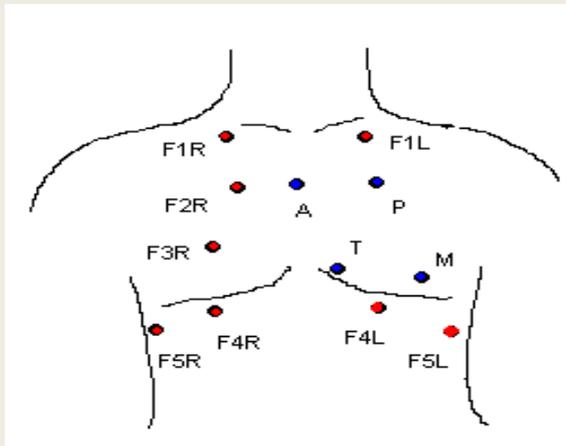
# Medical M&S Application Areas

- Training and Diagnostic Tools
- Patient Care and Treatment
- Infectious Disease Spread
- Hospital Operations

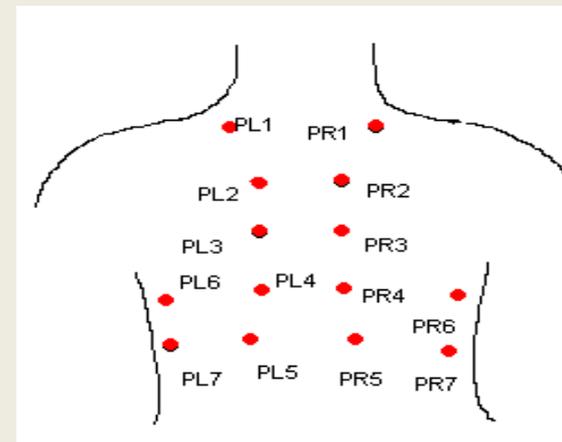
# Training and Diagnostic Tools

## Virtual Pathology Stethoscope

- Used in tandem with a standardized patient (SP)
- “Tracked VPS” or wireless control
- Substitutes abnormal sounds for healthy sounds, supporting diagnostic training
- Licensed by Cardionics Inc.
- Partners include ODU, EVMS/



Anterior Heart & Lung Sound Locations ( 12)



Posterior Heart & Lung Sound Locations (14)

## **Virtual Pathology Sonography**

- Computer generated dynamic organ models
- Sonograph of fetus is shown
  - Virtual fetus is placed in real environment on SP that is not pregnant.
  - Practice proper placement and hand-eye coordination
- Selection of injury/disease effects
- ODU, EVMS

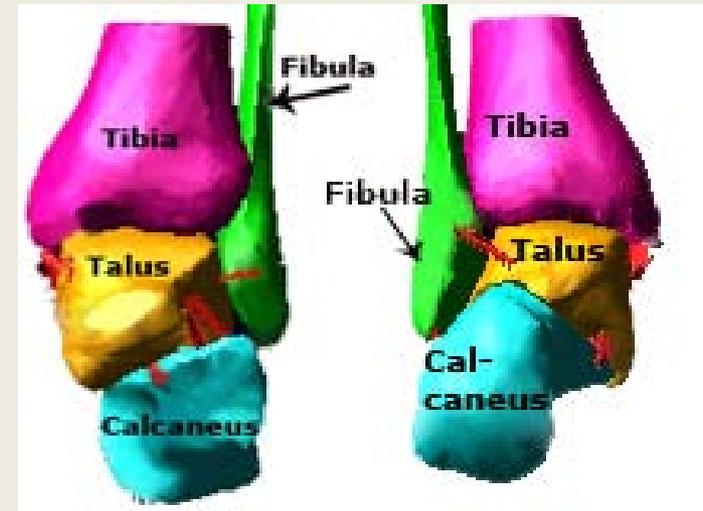


## **Monarch General**

- Virtual hospital for nurse education
  - Interact patient avatars
  - Variety of illnesses and injuries
  - Nurses trained on admittance interviews
    - Patient priority
    - Immediate diagnostic requirements
    - Increased efficiency and accuracy
- Virtual Patient Library
- VMASC/ODU, EVMS

## Ankle Joint Injuries

- ▼ Mechanical engineering strength and fatigue analyses
- ▼ Strength models of bone and soft tissue (cadavers)
- ▼ Simulated injuries
- ▼ Diagnosis/treatment recommendations
- ▼ Future work will develop models to treat trauma and diseases on a patient specific basis



# Patient Care and Treatment

## Using Xbox 360 for Rehabilitation of Brain Injured Patients

- Improve patients' cognitive and motor skills
- Sponsored by Office of the Secretary of Defense, DoD.
- SBIR Phase I with MYMIC LLC.

### Brain Injury Rehabilitation Delivery System



Players



Games



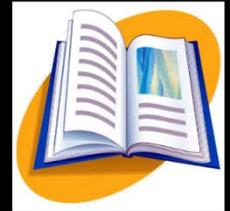
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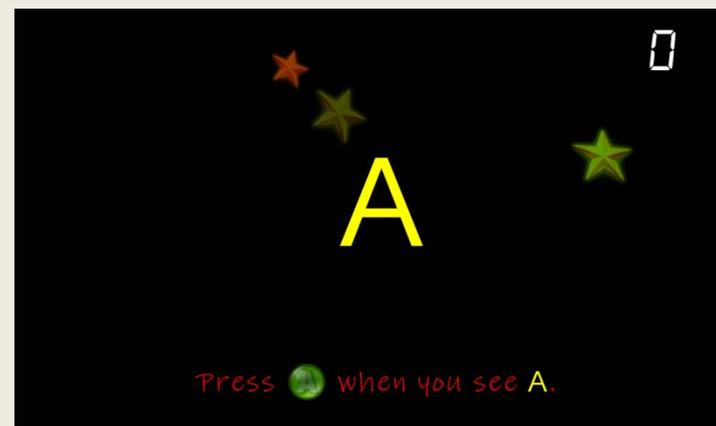
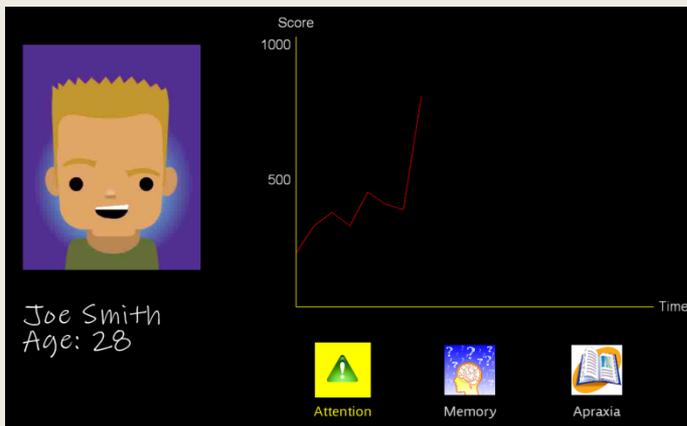
Attention



Memory



Apraxia

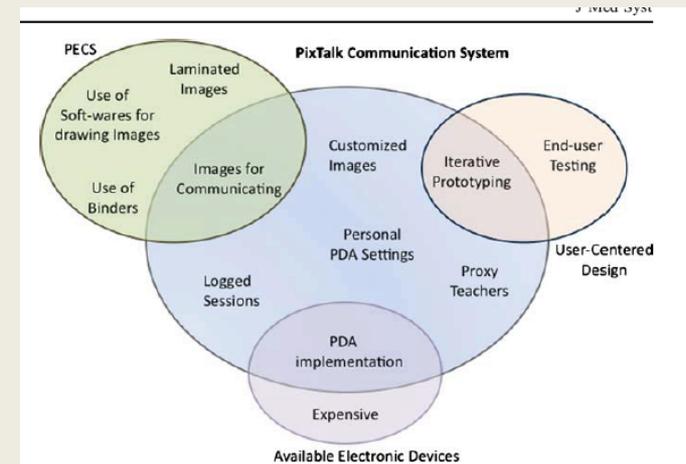


# Modeling Communication

## Helping Children with Severe Autism Communicate



**Funded by Microsoft Research  
Partner: Clermont University, CA**



# *Patient Care and Treatment*

## **Virtual Reality Helping Children with Cerebral Palsy Walk**



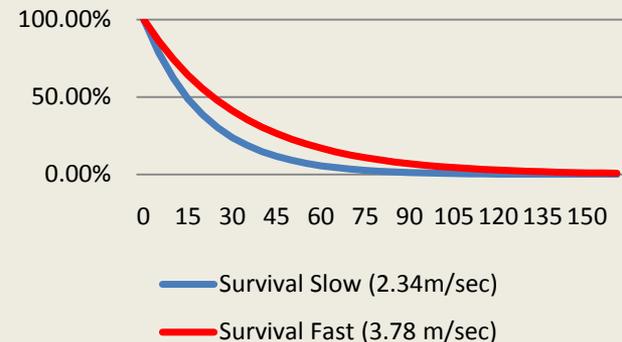
# Development and Assessment of Physical Training Regimes



- Assess importance of individual physical fitness on survivability
- Data collection funded by ONR. Measure 12 meter “rush speeds

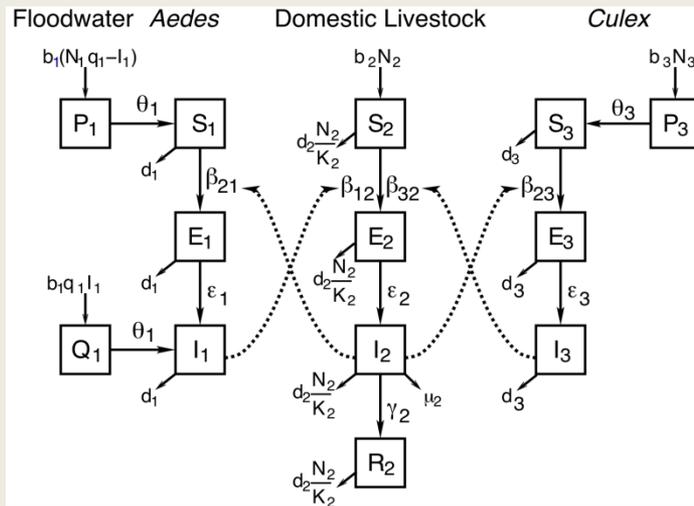
- Opposed helicopter extraction model
- Improved modeling can be used to improve tactical planning

Survivability vs Rushing Distance (m)



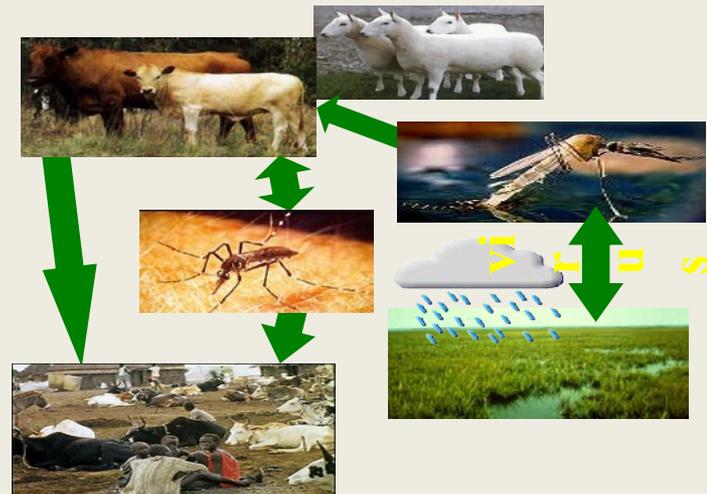
# Infectious Disease Spread

## Tick-Borne Diseases: Rift Valley Fever



- Collecting ticks from coastal Virginia sites from May through October
- Develop and use model to predict optimal control strategy

- Funded by NIH
- Partners: ODU, Johns Hopkins, U. Maryland, U. Michigan

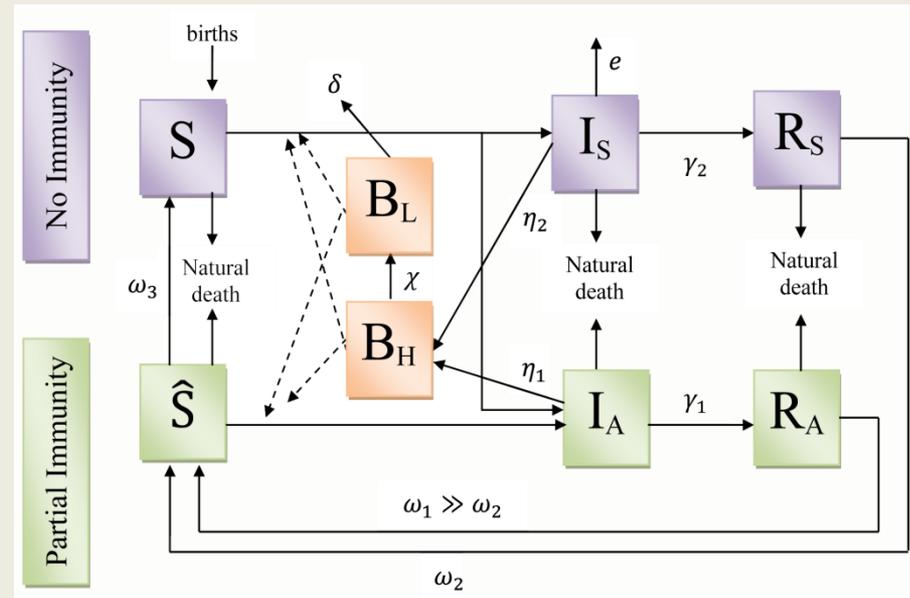


# Infectious Disease Spread

## Optimal Strategies for Controlling Cholera Outbreaks

- Assess compliance to infection control protocols
- Analyze potential spread of a pathogen
- Increase awareness through visualization
- Funded by NSF
- Partners: ODU, Murray State U., Marymount U., U. of TN

### Cholera Model structure



# *Hospital Operations*

## **Disaster Medical Assistance Team – DMAT Gaming Solution for Training and Assessment**



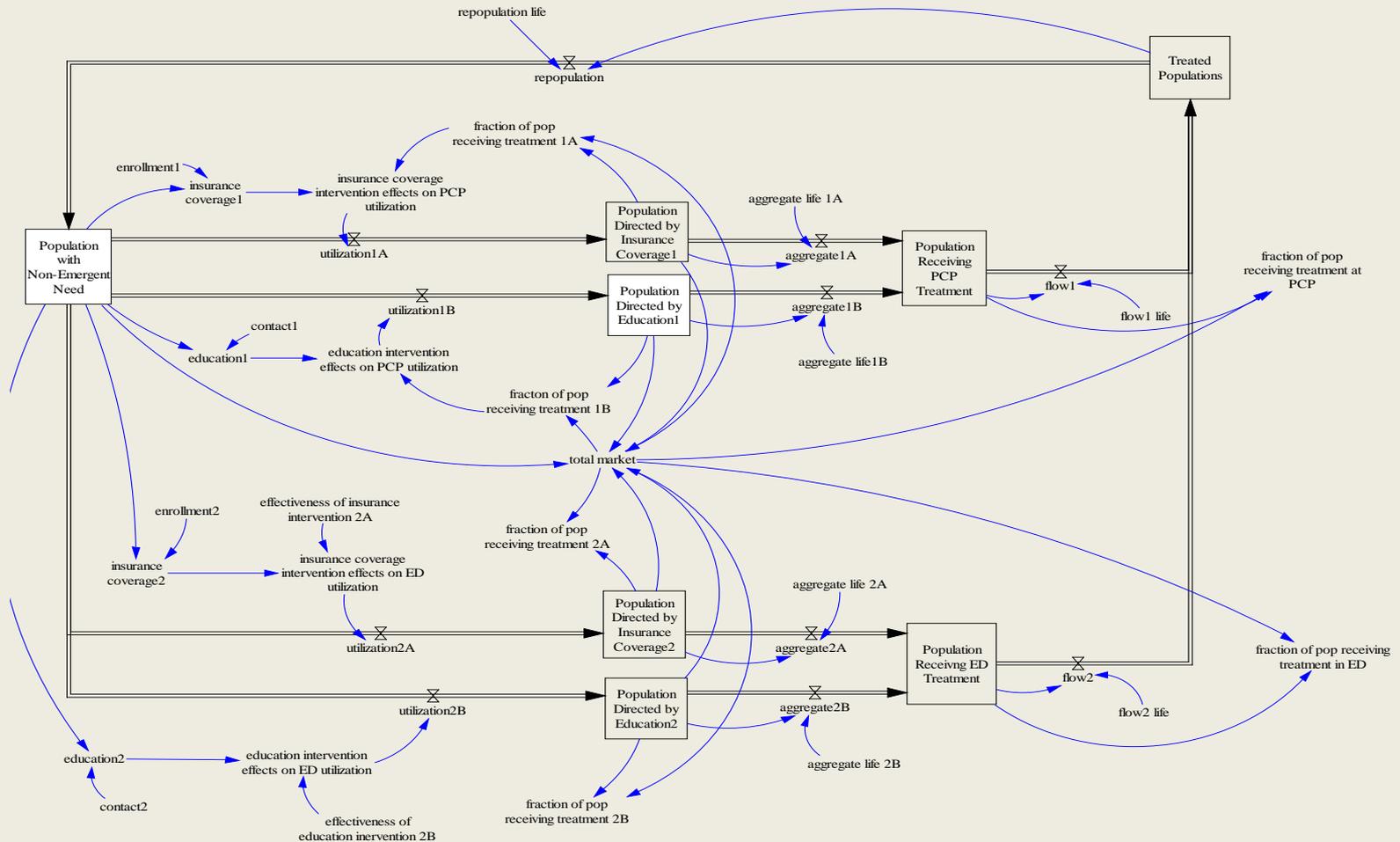
**Funded by** Mymic LLC through SBIR Phase I and II (2007-2010)

**Partners:** Mymic LLC, Forterra System Inc

**Goal:** Improve medical response team efficacy using research oriented short experiments and game based training

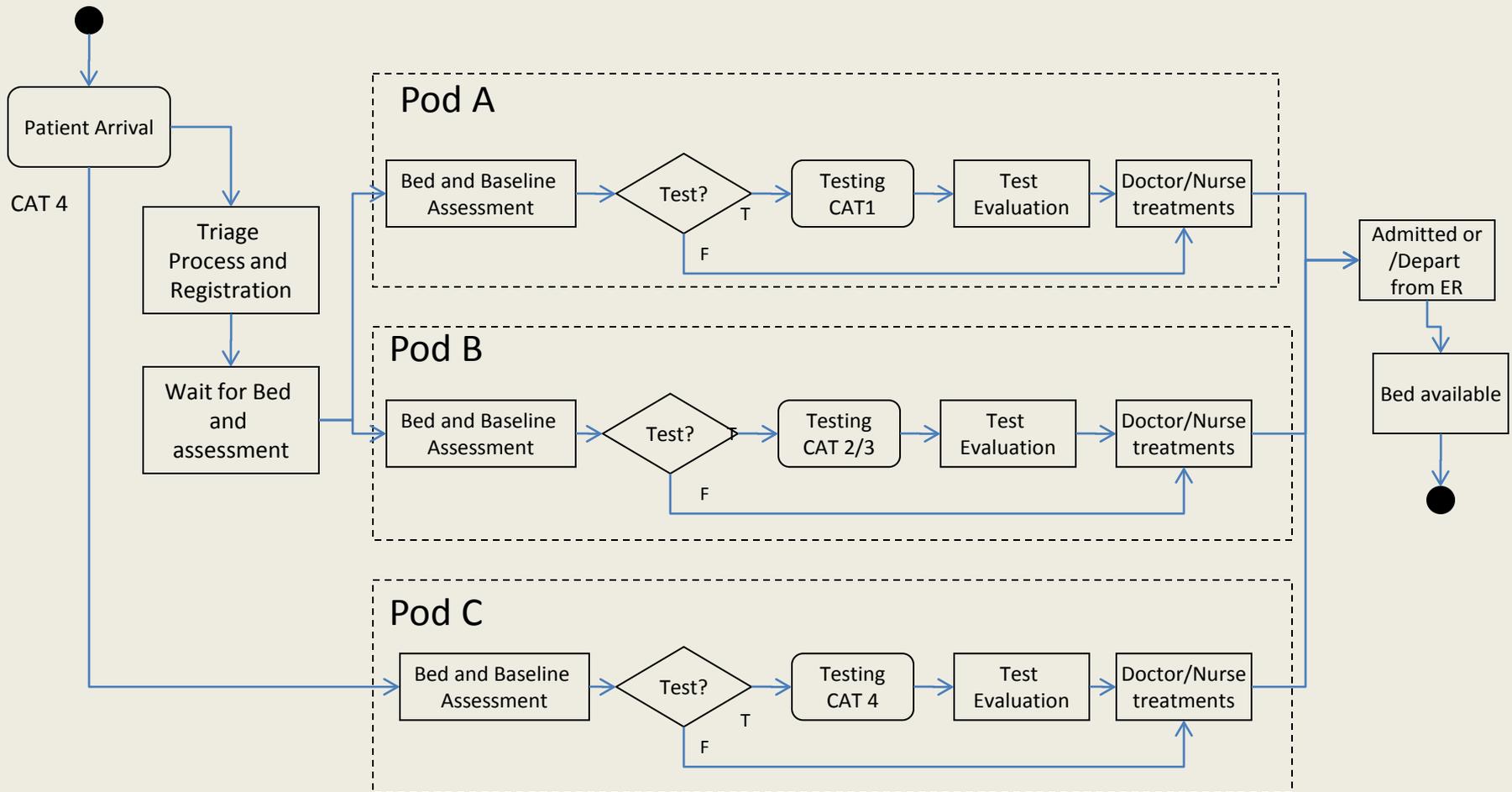
# Hospital Operations

## Modeling the Sensitivity of Inappropriate Emergency Department Utilization



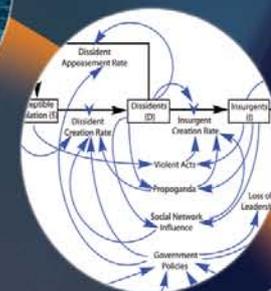
# Hospital Operations

## Optimizing Emergency Department Resources



applied  
**RESEARCH**

**V M A S C**  
Old Dominion UNIVERSITY



virginia  
**MODELING,  
ANALYSIS** and  
SIMULATION  
**CENTER**

Virtual Environments

Defense & Homeland Security

Transportation

Medical & Healthcare

Business & Supply Chain

Social Sciences

Game-Based Education

[www.vmasc.odu.edu](http://www.vmasc.odu.edu)

# Backup Slides

- Developing an internet based rehabilitation program for warfighters with functional hearing loss secondary to blast and/or mTBI (*OSD, SBIR-phase I and II*)
  - *Dr. Stacie Ringleb*
  - *ODU*
- Developing VR assessment modules to determine return to duty and affective (*OSD*)
  - *Dr. Stacie Ringleb*
  - *ODU*
- Improving VR based rehabilitation systems to treat stroke patients and collecting fMRI data on these patients (*ODU's Office of Research*)

- GaMeTT: Create a computer game-based software tool to track, assess, and train medical support teams to operate under stressful conditions. (*Mymic LLC*)
  - Dr. Gianluca De Leo
  - *VMASC/ODU, Mymic LLC, Forterra Inc*
- Iphone Application for Emergency Preparedness (*Hampton Roads Planning District Commission*)
  - Dr. Gianluca De Leo
  - *VMASC/ODU*