Surgical Simulation
Comprehensive Curriculum on a Low Budget
No conflicts of interest to report.
SES064

Surgical Simulation: Comprehensive Curriculum on a Low Budget

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Mohsen Shabahang, MD, PhD
Agenda

- Group Assignments
- Literature Review
- ACS/APDS Surgical Skills Curriculum
- Geisinger General Surgery’s Simulation Curriculum
Group Assignments

Group 1: Challenges

Group 2: Purpose

Group 3: Teaching Tools

Group 4: Evaluations
Challenges of Simulation

• Group Comments
Challenges of Simulation

- **Personnel-related barriers**
  - Lack of faculty protected time
  - Limited personnel
  - Lack of faculty incentives

- **Learner-related barriers**
  - Work-hour restrictions
  - Lack of resident protected time
  - Lack of resident motivation

- **Administrative-related barriers**
  - Cost
  - Lack of trained faculty
  - Lack of cadaveric facilities
  - Lack of perceived need

Purpose of Simulation

• Group Comments
Purpose of Simulation

• Provides a learning environment that is safe
• To improve surgical technical skills
• Clinical situation and technical skill exposure
• Mechanism to accelerate learning curves
• Measures proficiency
Teaching Tools

• Group Comments
Teaching Tools

• Open Simulator
• FLS Box
• FES Simulator
• Virtual Reality
• SimMan
• Standardized Patients
# Teaching Tools

<table>
<thead>
<tr>
<th>Simulation Type</th>
<th>Example of Skill Objective</th>
<th>Commercially Available Simulation Models</th>
</tr>
</thead>
</table>
| Partial Task        | • Suturing  
                      • Knot tying  
                      • Anastomosis                              | • Basic open surgical skills (BOSS)  
                      • Knot-tying boards  
                      • Suture pads  
                      • Simulated tissue models  
                      • Small and large intestines  
                      • Vessel dissection trainer  
                      • Wound-closure models |
| Procedure Specific  | • Pyeloplasty  
                      • Vascular access  
                      • Common bile duct  
                      • Exploration  
                      • Carotid endarterectomy  
                      • Hernia repair  
                      • Thoracentesis  
                      • Coronary artery bypass graft        | • Adult/adolescent/pediatric pyeloplasty model  
                      • Central line models  
                      • Femoral line models  
                      • Common bile duct exploration  
                      • Inguinal hernia model/hernia trainer  
                      • Carotid artery shunt trainer  
                      • TraumaMan  
                      • Various heart models with disease  
                      • Saphenous vein trainers |
<table>
<thead>
<tr>
<th>Simulation</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Best Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bench Models</strong></td>
<td>Cheap, portable, reusable, minimal risks</td>
<td>Acceptance by trainees; low fidelity; basic tasks; not operation</td>
<td>Basic skills for novice learners, discrete skills</td>
</tr>
<tr>
<td><strong>Live Animals</strong></td>
<td>High fidelity, availability, can practice hemostasis and entire operations</td>
<td>Cost, special facilities and personnel required, ethical concerns, single use, anatomical differences</td>
<td>Advanced procedural knowledge, procedures in which blood flow is important, dissection skills</td>
</tr>
<tr>
<td><strong>Cadavers</strong></td>
<td>High fidelity, only “true” anatomy simulator currently, can practice entire operations</td>
<td>Cost, availability, single use, compliance of tissue, infection risk</td>
<td>Advanced procedural knowledge, dissection, continuing medical education</td>
</tr>
<tr>
<td><strong>Human Performance Simulators</strong></td>
<td>Reusable, high fidelity, data capture, interactivity</td>
<td>Cost, maintenance, and downtime; limited “technical” applications</td>
<td>Team training, crisis management</td>
</tr>
<tr>
<td><strong>Virtual Reality Surgical Simulators</strong></td>
<td>Reusable, data capture, minimal set up</td>
<td>Cost, maintenance, and downtime; acceptance by trainees; three dimensions not well simulated</td>
<td>Basic laparoscopic skills, endoscopic and transcutaneous procedural skills</td>
</tr>
</tbody>
</table>

Evaluation

• Group Comments
Evaluation

- Performance Evaluation
  - Pre-training assessment
  - Post-training assessment

- Curriculum Evaluation
  - Evaluation of the program
  - Evaluation of conveying the education
  - Summative feedback

Evaluation

• Examples of Assessments
  • OSCE: Objective Structured Clinical Examinations
  • OSATS: Objective Structured Assessment of Technical Skills
  • GRS: Global Rating System
  • Error Score Card Analysis
  • Outcome Measures (suture leakage, cross-sectional area, suture spacing)

<table>
<thead>
<tr>
<th>Traditional Skill Assessment Methods</th>
</tr>
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<tbody>
<tr>
<td>Method</td>
</tr>
<tr>
<td>Procedure list with logs</td>
</tr>
<tr>
<td>Direct observation</td>
</tr>
<tr>
<td>Direct observation with criteria</td>
</tr>
<tr>
<td>Animal models with criteria</td>
</tr>
<tr>
<td>Videotapes</td>
</tr>
</tbody>
</table>

ACS/APDS
Surgical Skills Curriculum
### Phase 1: Basic/Core Skills and Tasks

- Asepsis and Instrument Identification
- Knot Tying
- Suturing
- Tissue Handling, Dissection, Wound Closure, Wound Management
- Advanced Tissue Handling: Flaps, Skin Grafts
- Catheterization, Urethral and Suprapubic
- Airway Management
- Chest Tube and Thoracentesis
- Central Line Insertion, Arterial Lines
- Surgical Biopsy
- Vascular Anastomosis
- Laparotomy Opening and Closure
- Principles of Bone Fixation and Casting
- Introduction to Inguinal Anatomy
- Upper Endoscopy
- Colonoscopy
- Basic Laparoscopy Skills
- Hand-sewn Gastrointestinal Anastomosis
- Stapled Gastrointestinal Anastomosis

### Phase 2: Advanced Procedures

- Laparoscopic Ventral Hernia Repair
- Open Colon Resection, Laparoscopic Right Colon Resection
- Laparoscopic Sigmoid Resection
- Open Right Colon Resection
- Laparoscopic/Open Bile Duct Exploration
- Laparoscopic Ventral/Incisional Hernia Repair
- Laparoscopic Appendectomy
- Laparoscopic Nissen Fundoplication
- Sentinel Node Biopsy and Axillary Lymph Node Dissection
- Open Inguinal/Femoral Hernia Repair
- Laparoscopic Inguinal Hernia Repair
- Laparoscopic/Open Splenectomy
- Laparoscopic/Open Cholecystectomy
- Gastric Resection and Peptic Ulcer Disease
- Parathyroidectomy/Thyroidectomy
Phase 3: Team Based Skills

Teamwork in the Trauma Bay
Postoperative Hypotension
Laparoscopic Crisis
The Preoperative Briefing
Laparoscopic Troubleshooting
Postoperative Pulmonary Embolus
Postoperative MI
Latex Allergy Anaphylaxis
Patient Handoff
Retained Sponge on Postop Chest X-Ray
Geisinger Department of Surgery Simulation Curriculum

- Intern Boot Camp
- Fundamentals of Endoscopic Surgery
- Fundamentals of Laparoscopic Surgery
- FAST Ultrasound
- Three Module Ultrasound
- Vascular Anastomosis
- Cadaver Laboratory
- Open Abdomen
- Team Building Scenarios
- Gift of Life
## Simulation Chart

<table>
<thead>
<tr>
<th>JUL</th>
<th>AUG</th>
<th>SEPT</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
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<tbody>
<tr>
<td>IBC Day 1 PGY1 7/17 8-5pm MORGAN</td>
<td>IBC Day 2 PGY1 8/1 730-12pm</td>
<td>FES PGY1 10/9 8am-11am HALM</td>
<td>FES TEST PGY1 11/20 8-10am WIDGER</td>
<td>FES TEST PGY2 12/9 MORGAN</td>
<td>FES TEST PGY2 1/13 MORGAN</td>
<td>Team Building PGY2&amp;P3 3/10 730-1230pm KUPAS/MORGAN</td>
<td>FES PGY3 TBD</td>
<td>FES PGY3 TBD</td>
<td>FES PGY2 TBD</td>
<td></td>
<td></td>
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<tr>
<td>FLS PGY2 9/22 12-1pm ALAPARTHI</td>
<td>FLS PGY3 10/20 12-2pm ALAPARTHI</td>
<td>FLS PGY2 11/24 12-1pm ALAPARTHI</td>
<td>FLS PGY1 12/15 12-2pm ALAPARTHI</td>
<td>FLS PGY2 2/9 12-1pm ALAPARTHI</td>
<td>FLS PGY2 3/2 12-1pm PGY1 3/30 12-2pm ALAPARTHI</td>
<td>FLS PGY3 4/13 12-1pm ALAPARTHI</td>
<td>FLS PGY2 5/11 12-1pm ALAPARTHI</td>
<td>FLS PGY1 6/1 12-2pm ALAPARTHI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAST PGY2&amp;4 10/17 9-11am TORRES</td>
<td>Thyroid &amp; Vascular Ultrasound PGY3 11/13 2-4pm RYER/HU</td>
<td>Vas 12/2 PGY2 2:00-3:30pm PGY3 3:30-5:00pm RYER</td>
<td>Breast Ultrasound PGY3 1/15 8-9am WIDGER</td>
<td>Cadaver PGY1-5 2/5 MORGAN</td>
<td>Cadaver PGY1-5 3/5 MORGAN</td>
<td>Cadaver PGY1-5 4/9 MORGAN</td>
<td>ACS Course PGY5 5/7 12-4pm MORGAN</td>
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<td></td>
<td>CBC PGY5 6/1, 6/2, 6/3 WOLFE</td>
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</tbody>
</table>

- **FLS PGY3**: 7/28 12-1pm ALAPARTHI
- **FLS PGY2**: 9/22 12-1pm ALAPARTHI
- **FLS PGY1**: 10/20 12-2pm ALAPARTHI
- **FAST PGY2&4**: 10/17 9-11am TORRES
- **Thyroid & Vascular Ultrasound PGY3**: 11/13 2-4pm RYER/HU
- **Vas**: 12/2 PGY2 2:00-3:30pm PGY3 3:30-5:00pm RYER
- **Breast Ultrasound PGY3**: 1/15 8-9am WIDGER
- **Cadaver PGY1-5**: 2/5 MORGAN
- **Cadaver PGY1-5**: 3/5 MORGAN
- **Cadaver PGY1-5**: 4/9 MORGAN
- **ACS Course PGY5**: 5/7 12-4pm MORGAN
- **CBC PGY5**: 6/1, 6/2, 6/3 WOLFE
- **Open PGY1&2**: TBD 1-3pm SHABAHANG
- **GOL PGY2&4**: 4/22 TORRES
- **Open PGY3&5**: 5/21 1-3pm SHABAHANG
- **Open PGY2**: 6/4 1-3pm SHABAHANG
## Intern Boot Camp

### Day 1: Topics

<table>
<thead>
<tr>
<th>Time</th>
<th>Topics</th>
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<tbody>
<tr>
<td>8:00-9:00am</td>
<td>Emotional Intelligence</td>
</tr>
<tr>
<td>9:00-10:00am</td>
<td>Post-Op Scenarios &amp; Pain</td>
</tr>
<tr>
<td>10:00-11:00am</td>
<td>Common Operations/Imaging</td>
</tr>
<tr>
<td>11:00-12:00pm</td>
<td>BREAK</td>
</tr>
<tr>
<td>12:00-1:00pm</td>
<td>Common Clinic Scenarios/Hernias</td>
</tr>
<tr>
<td>1:00-2:00pm</td>
<td>Bariatric Surgery</td>
</tr>
<tr>
<td>2:00-3:00pm</td>
<td>ICU</td>
</tr>
<tr>
<td>3:00-3:30pm</td>
<td>BREAK</td>
</tr>
<tr>
<td>3:30-4:00pm</td>
<td>Trauma Scenarios</td>
</tr>
<tr>
<td>4:00-5:00pm</td>
<td>Trauma Service</td>
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</table>

### Day 2: Joint Session - Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Day 2: Joint Session</th>
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</thead>
<tbody>
<tr>
<td>7:30-8am</td>
<td>Breakfast and Overview</td>
</tr>
<tr>
<td></td>
<td>Dr. Shabahang</td>
</tr>
<tr>
<td>8-8:30am</td>
<td>Central Line Introduction</td>
</tr>
<tr>
<td></td>
<td>Strony</td>
</tr>
<tr>
<td></td>
<td>Central Line Rm 110</td>
</tr>
<tr>
<td></td>
<td>FAST Ultrasound Exam Lab</td>
</tr>
<tr>
<td></td>
<td>SimMan</td>
</tr>
<tr>
<td></td>
<td>Sim Lab</td>
</tr>
<tr>
<td>8:30-9:50am</td>
<td>Group A</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
</tr>
<tr>
<td></td>
<td>Group C</td>
</tr>
<tr>
<td>10-11:20am</td>
<td>Group C</td>
</tr>
<tr>
<td></td>
<td>Group A</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
</tr>
<tr>
<td>11:30am–12:50pm</td>
<td>Group B</td>
</tr>
<tr>
<td></td>
<td>Group C</td>
</tr>
<tr>
<td></td>
<td>Group A</td>
</tr>
<tr>
<td>12:50-1pm</td>
<td>EVALUATIONS</td>
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</tbody>
</table>

### Day 3: Topics

<table>
<thead>
<tr>
<th>Time</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-8:30am</td>
<td>Pediatrics</td>
</tr>
<tr>
<td>8:30-9:00am</td>
<td>Feeding Tube/Drains</td>
</tr>
<tr>
<td>9:00-10:30am</td>
<td>Suturing/Knot Tying/Open Simulation</td>
</tr>
<tr>
<td>10:30-12:00pm</td>
<td>Stapling</td>
</tr>
<tr>
<td>12:00-1:00pm</td>
<td>Wound Ostomy</td>
</tr>
<tr>
<td>1:00-2:00pm</td>
<td>FLS</td>
</tr>
<tr>
<td>2:00-3:00pm</td>
<td>Emotional Intelligence</td>
</tr>
<tr>
<td>3:00-4:00pm</td>
<td>FES</td>
</tr>
<tr>
<td>4:00-5:00pm</td>
<td>OR Tools</td>
</tr>
</tbody>
</table>
Fundamentals of Endoscopic Surgery

- ABS Flexible Endoscopy Curriculum
- Endoscopy Simulator

**PGY 1: Introduction**
- Four hour didactic session
- Four practice tests
- One test session

**PGY 2: Biopsy**
- Two hour didactic session
- Four practice tests
- One test session

**PGY 3: Polypectomy**
- Two hour didactic session
- Four practice tests
- One test session
Fundamentals of Laparoscopic Surgery

• SAGES FLS Curriculum
• Box Simulators
• PGY 1: two hour sessions (4x/year)
• PGY 2: one hour sessions (4x/year)
• PGY 3: one hour sessions (4x/year)
• MUST pass by end of PGY 3 year

Evaluation
• Rate each category (peg transfer, pattern cut, endoloop, extracorporeal and intracorporeal suturing)
• Document elements of each category (no drops, time, accuracy, overall performance)
FAST Ultrasound

- FAST Ultrasound Machine
- PGY 2 and 4
- Live patients
  - One positive
  - One negative
- Evaluation
  - Handling of equipment
  - Examined all four windows
  - Identifying free fluid
  - Evaluation of pneumothorax
  - Articulate indications/limitations
Three Module Ultrasound

- PGY 3
- Breast
  - Model: turkey breast and olives
  - Breast surgeon
- Thyroid
  - Model: Residents
  - Endocrine physician
- Vascular
  - Model: residents
  - Vascular surgeon
Vascular Anastomosis

- PGY2: 90 minute session
- PGY3: 90 minute session
- Vascular surgeons
- Vascular reps
  - Simulators (leg, neck, etc)
  - Suture
  - Tools
- Evaluation
  - Steps
  - Economy of time and motion
  - Final rating
  - Summative comments
Cadaver Laboratory

- All PGY levels
- 2 ½ year curriculum
- Thoracic, Colorectal, Foregut, Vascular, Laparoscopic, Trauma

- Three days per year, two specialties per year, one cadaver per day

- Evaluated on:
  - Case difficulty, degree of prompting/direction, instrument handling, respect for tissue, time and motion, operation flow, strengths and weaknesses, and overall performance
Open Abdomen

• PGY 1-5
  • Knot tying and precision suturing, Bowel anastomosis, Ttube placement, common bile duct, and transanal procedures

• Bucknell engineering students
Open Abdomen

Version 1.1

Version 1.2
Team Building Scenarios

- Surgery (PGY2 & 3) and EM residents
- One five hour session once per year
- Didactic session
- Trauma scenario with SimMan
Gift of Life

• One hour didactic session
  • *Explaining Brain Death to the Grieving Family*
  • All residents
  • Gift of Life representative
  • Heart recipient

• One additional hour of mock scenarios
  • PGY2-4
Evaluations of Residents

**SIMULATION 2014-2015**

**Activity:** Joint Simulation  
**Faculty:** Shabahang, Semian, Torres, Wild, Strongy, and Stella

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### A. Overall, did you feel that the simulation activity met your needs and expectations?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
<th>Tend to Disagree</th>
<th>Don't Know</th>
<th>Tend to Agree</th>
<th>Agree</th>
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</thead>
<tbody>
<tr>
<td>Central Line</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>FAST Ultrasound</td>
<td>1</td>
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<td>5</td>
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<tr>
<td>SimMan</td>
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</tbody>
</table>

### B. Did you feel the objectives and content of the simulation activity were useful, appropriate, and pertain to your level of training?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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</tbody>
</table>

### C. Did you feel the faculty was fully prepared and effective at teaching and guiding the simulation activity?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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</tbody>
</table>

### D. Did you feel there was adequate time for learning and practicing the skills?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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### E. Do you feel this simulation activity will have impact on your “real life” skills?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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**ULTRASOUND SIMULATION**

**Resident Evaluation of Session 2014-2015**

**Resident:**  
**Date:**

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**BREAST ULTRASOUND**

A. Did the resident understand the ultrasound machine and its basic functions to assess image quality?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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</table>

B. Did the resident differentiate between normal and abnormal anatomy of the breast?

<table>
<thead>
<tr>
<th></th>
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</table>

C. Did the resident perform ultrasound-guided biopsies of the simulated breast?

<table>
<thead>
<tr>
<th></th>
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<th>Tend to Agree</th>
<th>Agree</th>
</tr>
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<tbody>
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</tbody>
</table>

D. Overall, did the resident perform as hit or her expected level?

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
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<th>Don't Know</th>
<th>Tend to Agree</th>
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**HYPOPHARYNX ULTRASOUND**

A. Did the resident understand the ultrasound machine and its basic functions to assess image quality?

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<tr>
<th></th>
<th>Disagree</th>
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<th>Don't Know</th>
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B. Did the resident differentiate between normal and abnormal anatomy of the thyroid?

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<th></th>
<th>Disagree</th>
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C. Overall, did the resident perform at hit or her expected level?

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<tr>
<th></th>
<th>Disagree</th>
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<th>Don't Know</th>
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**VASCULAR ULTRASOUND**

A. Did the resident understand the ultrasound machine and its basic functions to assess image quality?

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<th></th>
<th>Disagree</th>
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<th>Don't Know</th>
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B. Did the resident differentiate between normal and abnormal anatomy of the blood vessels?

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C. Overall, did the resident perform at hit or her expected level?

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<th></th>
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<th>Agree</th>
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Additional Comments: Please write your comments in the appropriate box listed below.

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<tr>
<th></th>
<th>Disagree</th>
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<th>Don't Know</th>
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<tbody>
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<tr>
<td>FAST Ultrasound</td>
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<td>SimMan</td>
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**GEISINGER**

REDEFINING BOUNDARIES®
Evaluation of Sessions

**SIMULATION 2014-2015 INTERN BOOT CAMP**

A. Overall, did you feel that Boot Camp met your needs and expectations?

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B. Did you feel the objectives and content of the sessions were useful, appropriate, and pertain to your level of training?

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C. Did you feel the faculty was fully prepared and effective at teaching and guiding the activities?

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D. Did you feel there was adequate time for learning during each session?

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E. Do you feel that Boot Camp will have impact on your “real-life” technical skills and knowledge?

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F. Please check all of the sessions you felt were beneficial to our program. If you feel the session wasn’t a great use of time, please explain why:

- Provider
- Pelvic Scenarios Pain
- Common Operations
- Imaging
- Trauma Service
- Trauma Scenarios
- Ballistic Surgery
- ICU
- Wound Ostomy/IUC
- Common Clinic Scenarios/Herpes
- OR Tools
- Suturing/Knot TYing
- Open Simulation
- Stapling
- Feeding Tube/Drains
- FLS
- FES
- OR Trip

Additional changes you would make (please explain):
Simulation Survey Results

- **Intern Boot Camp**
  - Positives: Great introduction to program, learned a lot, sessions have improved
  - Comments: Night shift was difficult, sessions during orientation would be better, keep updating based on current interns feedback

- **Fundamentals of Endoscopic Surgery**
  - Positives: Gives excellent opportunity to become familiar with the scope and how to handle it, good for practice
  - Comments: Not very real, not useful after PGY2 year, location isn’t convenient

- **Fundamentals of Laparoscopic Surgery**
  - Positives: Strong and well organized curriculum, easy 24/7 access, great practice
  - Comments: Need better stock of materials/instruments, could use simulator in resident room, split into smaller groups

- **FAST Ultrasound**
  - Positives: Realistic, great for PGY1-2 skills, helped get oriented to machine
  - Comments: Do earlier in residency, more patients, review machine more

- **Three Module Ultrasound**
  - Positives: Taught by content experts, good hands-on experience
  - Comments: Add another vascular session, no more sessions required since experience and practice achieved in trauma bay
Simulation Survey Results

- **Vascular Anastomosis**
  - Positives: Dedicated faculty, great simulators, excellent for practicing skills needed in the OR
  - Comments: Allow 3x the amount of time, add another session, break into smaller groups

- **Cadaver Laboratory**
  - Positives: Most realistic simulation, excellent for learning anatomy and procedures not often done in the OR
  - Comments: More sessions, pre discussion before procedures, break into smaller groups

- **Open Abdomen**
  - Positives: Models have improved over time, good introduction to knot tying and basic surgical skills
  - Comments: Infrequent sessions, increase use of models

- **Team Building Scenarios**
  - Positives: Realistic, good ice breaker, builds communication, reinforces roles
  - Comments: Have earlier in the year, stressful, not sure what we can/can’t do with SimMan

- **Gift of Life**
  - Positives: Makes us aware of GOL and what they do, good for talking through simulated discussions
  - Comments: Simulation not realistic at all, no need for role playing, only need presentation
Conclusion

• Well thought out curriculum can be done on a low-budget

• Evaluation of Session
Thank you!

Dr. Fishner loved his new surgery app.