Simulation and Central Line Patient Safety

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Disclosure

- No financial interest in any simulation equipment or company

Objectives

- Be familiarized with simulation background in healthcare
- Review patient safety data of central line placement
- Review evidences of simulation training in central line placement and its patient safety improvement
- Review Olive View Central Line Simulation Pilot Project Data
Simulation Background

- How can one teach management of plane crash while the plane is really crashing?
- Simulation training concept started in World War I
- Standard of training pilots in aviation for decades
- Widely utilized in military

What is Simulation?

- It is a practice or tool to model after real-life or hypothetical event in order to examine certain goals and objectives

Translating to Medicine

- How to train a health care professional in a most fearful situation in a most controlled setting?
- How to explore one’s mistakes in such situation and learn without any expense on patient’s mortality and morbidity?
Translating to Medicine

- In 1969 at LAC+USC, “Sim One” was created by 2 anesthesiologists
- In early 80’s, anesthesiology began utilizing simulation to train for intra-operative disasters

Translating to Medicine: Usage of Simulation

- Rare but deadly events
  - Crashing patients, Code blue
- Common but high stake invasive procedures
  - Central Lines, Cath Lab
- For system/behavioral/cognitive issues
  - Team training, work flow, communication, cognitive errors

Translating to Medicine: Federal Recognition

- In 1999, “To Err is Human: Building a Safer Health System” by IOM officially supported education and certification should involve simulation.
- Since then, Surgery, OB-GYN, Medicine, Pediatrics, Surgery, Neurosurgery, Urology, GI, Cardiology, Critical Care, Emergency Medicine, and Nursing all use simulation.
Translating to Medicine:
Credentialing
- American Board of Anesthesiology institutes requirements for a simulation-based experience for Maintenance of Certification
- American Board of Internal Medicine institutes lab-based simulation for Interventional Cardiology requirement for Maintenance of Certification
- USMLE Step 2 Clinical Exam utilizes standardized patient simulation

Translating to Medicine:
Where is the money?
- In 2005, AHRQ (Agency for Healthcare Research and Quality) funded 5 millions to 19 simulation projects
  - In 2009, “Enhancing Safety in Medicine Utilizing Leading Advanced Simulation Technologies to Improve Outcomes Now (SIMULATION) Act” was proposed to increase federal support and funding
  - In 2010, AHRA is funding another 4.2 millions to simulation research

Simulation and Central Line Placement
- Central Venous Catherization (CVC) or Central line placement is of great interest
- Because currently “See one, do one, and teach one” is no longer accepted
- Because too many complications and too expensive to treat
Simulation and Central Line Placement:
Concept

- one can practice at the steepest portion of the learning curve and makes all the mistakes on a simulator instead of a real human being
- Saves lives, save complication, saves money

Simulation and Central Line Placement:
CDC Patient Safety Data

- Estimated 5 millions CVC placed annually in US
- In 2002, CDC estimated 250,000 CVC-associated infections and resulting mortality rate of 12 to 25 percent
- Each infection costs $56,000 to treat with total cost ranged from $296 million to $2.3 billion

Simulation and Central Line Placement:
CDC Patient Safety Data

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<th></th>
<th>IJ</th>
<th>SC</th>
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<tbody>
<tr>
<td>Infection rate*</td>
<td>0.8</td>
<td>4</td>
<td>15.3</td>
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<tr>
<td>Thrombosis rate*</td>
<td>1–3</td>
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<td>Arterial puncture</td>
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<td>0.5%</td>
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<td>1.5–3%</td>
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<tr>
<td>Hemothorax</td>
<td>1/4a</td>
<td>0.4–0.6%</td>
<td>1/4</td>
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* = rate per 1000 catheter-days
Adapted from, Graham AS, et al Central Venous Catheterization, Video in Clinical Medicine series. NEJM 356; 21
Simulation and Central Line Placement: CDC Patient Safety Data

- It is extremely expensive to treat the complication
- While the federal reimbursement of treatment in 2008 plummeted
- Mandated by Section 5001(c) of the Deficit Reduction Act, hospitals now “will not receive additional payment for cases in which one of the selected conditions was not present on admission.”

Simulation and Central Line Placement: CDC Patient Safety Data

- Center of Disease Control (CDC) and Centers for Medicare and Medicaid Services (CMS) identified CVC-related complications as hospital-acquired conditions (HAC)
- Multiple recent events of guide-wire inadvertently left in the patient’s body after CVC placements at LA County facilities
- Official recognition by LA County DHS Patient Safety Committee in Simulation training of CVC Placement

Simulation and Central Line Placement: Simulation Evidences

- Britt RC et al (2009) found that simulation-trained residents have less complication rates in real patients than the standard group
- Velmahos GC (2004) found similar results in that the simulation-trained interns scored higher on the procedural check-list and less attempts to find the vein.
Evan LV, et al (2010) has the largest study, a prospective, randomized controlled study of 495 CVC observed in real patient over 21 months period. They found similar results of significant increased success completion and first attempt rate.

Wayne DB, et al (2009-2010) also found similar results of improved performances by simulation-trained residents. CVC-related blood infection frequency in simulation-trained group is significantly less. A total of 69 residents in IM and EM rotating in MICU were trained. A 7 to 1 rate of return on the simulation training intervention was found.

Prevented 10 infections/year in MICU patients with CVCs after the simulation training. The cost of each CVC-related were $82,000 and 14 additional hospital days (including 12 MICU days). The cost of the simulation-based education was $112,000. The net annual savings were thus greater than $700,000.
Simulation and Central Line Placement:
What does it mean?
- Simulation teaches residents better than traditional apprenticeship method
- Simulation teaches residents to make less mistakes and complication
- Less mistakes and complication=less cost=less mal-practice

Olive View Central Line Simulation Pilot Project
- A different angle
- What about the teacher’s performances?
- Aim to assess baseline CVC performances by graduating IM residents
- The senior residents are de facto teacher of CVC placement to the junior in academic institutions

Olive View Central Line Simulation Pilot Project
- Observational Pre and Post intervention study
- IRB approved
- Olive View Research Seed Grant supported
- 17/19 graduating IM residents as subjects
- All IJ CVC performances were video-recorded
- Blue Phantom CVC simulator (Kirkland, WA)
Olive View Central Line Simulation Pilot Project

**Pre-Test/Baseline Performances:**
- Only 12 residents were able to finish the placement
- 5 forfeited the procedures due to technical difficulties

**At pre-intervention:**
- Average of 4 needle sticks and 8 minutes were required before successful cannulation

**At post-intervention:**
- Average of only 1.5 sticks and 4 minutes

- ability to pass guide-wire on the first attempt
- landmark identification
- ultrasound usage
- obtaining consent
- inquiring contraindication before procedure
- appropriate sharps disposal were all improved after training
More importantly, 16 arterial punctures, 3 arterial cannulation, 1 AV fistula were observed at pre-intervention. Post-intervention, only 1 puncture and no cannulation were observed.

For those 5 residents who initially forfeited the procedure at baseline, after training, all of them were able to successfully place CVC with an average of 6 minutes before cannulation and 1.2 sticks.

Self-assessed confidence level improved from 5.7 at baseline to 8.3 post training. An average score of 9.1/10 was given by the residents to recommend formal simulation central line curriculum.
Discussion

- Concerning baseline performances by the de facto teachers in our hospital
- What would happen to our junior residents?
- What would happen when they become teachers as senior residents themselves?
- Effects on real patients outcomes by poor teachers?

Discussion

- How much does each arterial cannulation cost to repair?
- What if patient suffer from stroke?
- Malpractice insurance company offer discount to physician with simulation training in anesthesiology and OB

Discussion

- Different government/federal agents are pushing simulation onto us
- Wave of future
- High potential for different issues at different levels in our hospitals
References:


3. American Board of Internal Medicine official webpage available at: http://www.abim.org/moc/mk.aspx#simulations Last accessed at 7/30/09


