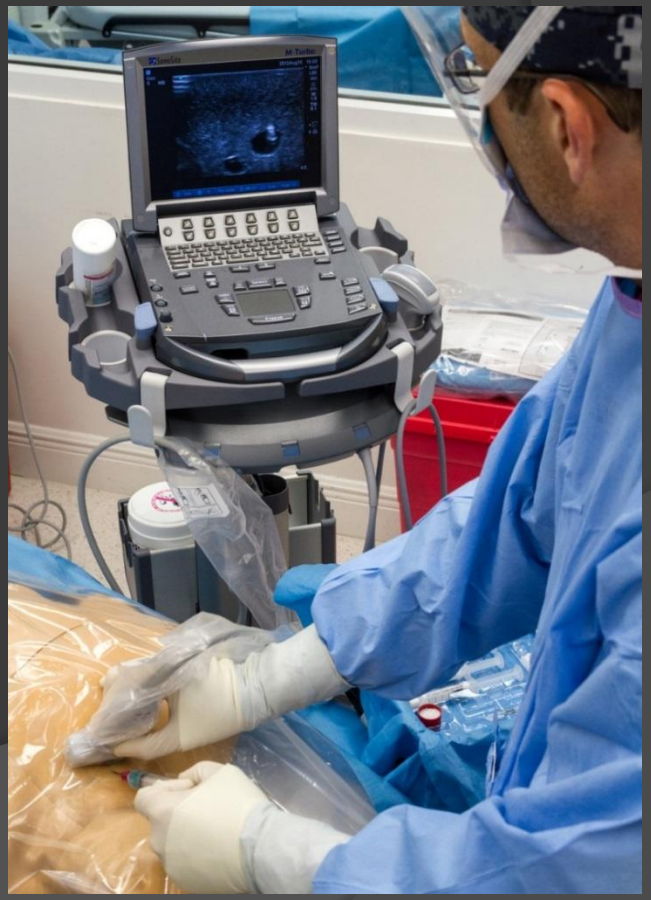
Simulation-based procedural training: Trading old habits for safer patient care

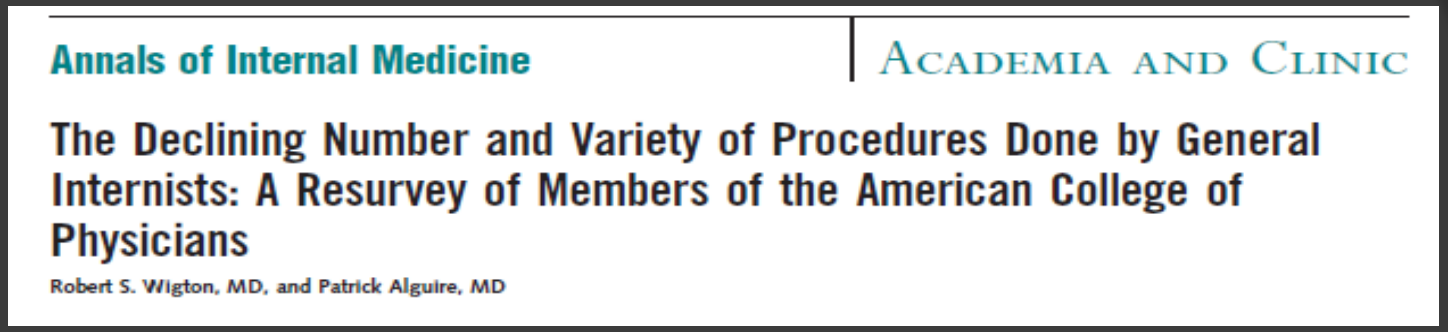


Joshua D. Lenchus, DO, RPh, FACP, SFHM
Regional Chief Medical Officer
Broward Health Medical Center
Ft. Lauderdale, FL

Financial Disclosures

None

Overview of bedside procedures



Annals of Internal Medicine | ACADEMIA AND CLINIC

The Declining Number and Variety of Procedures Done by General Internists: A Resurvey of Members of the American College of Physicians

Robert S. Wigton, MD, and Patrick Alguire, MD

Who did them?

Are they still doing them?

Who is and why?

What is wrong with the general status quo?

“Well, back in my day...”

- “See one, do one, teach one”
- Apprenticeship model
- Variable teaching and learning
- Competency determination

  To be or not to be a number?

- Why not continue on this same course?

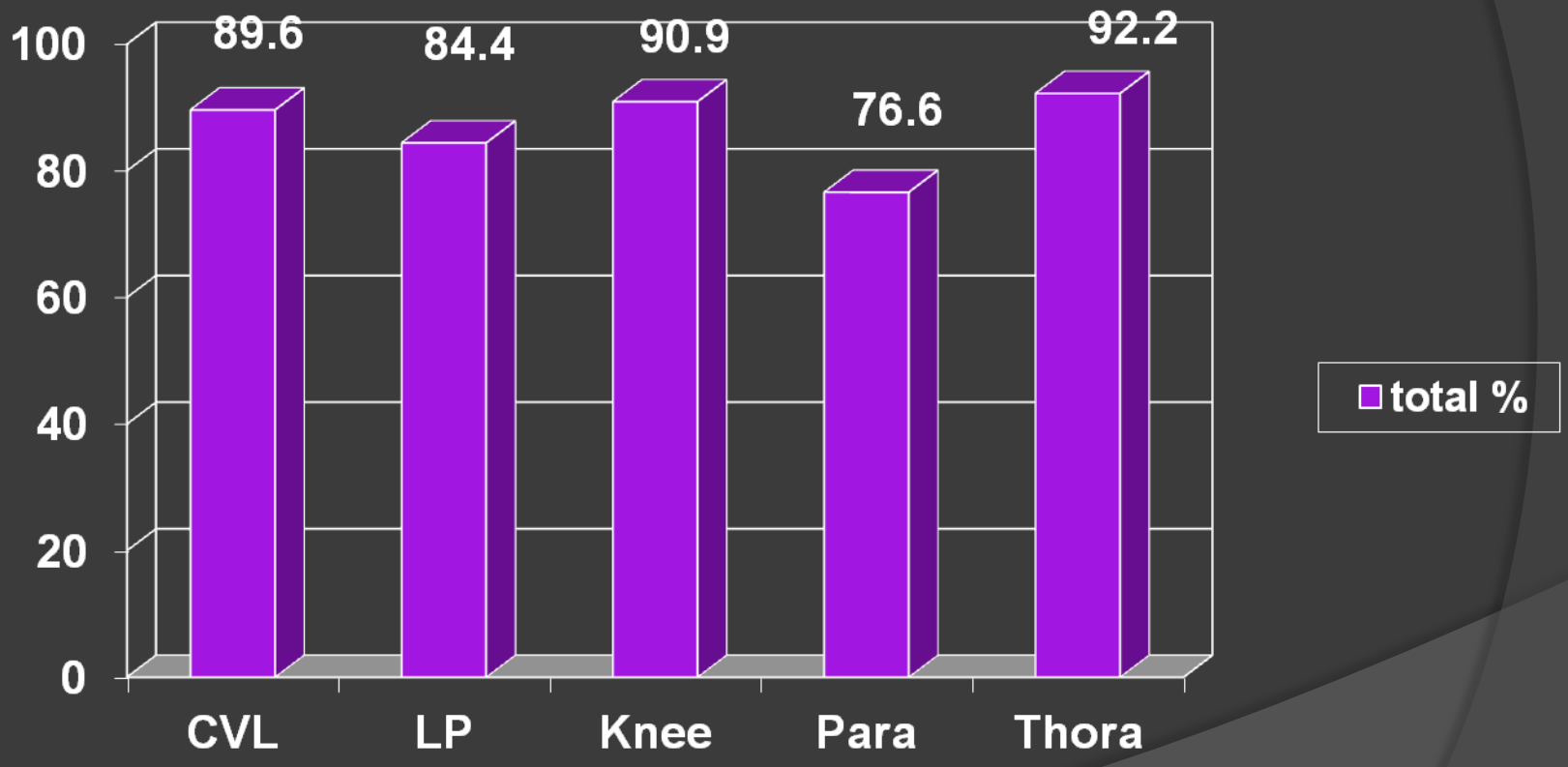
Then: “Houston, we have a problem”

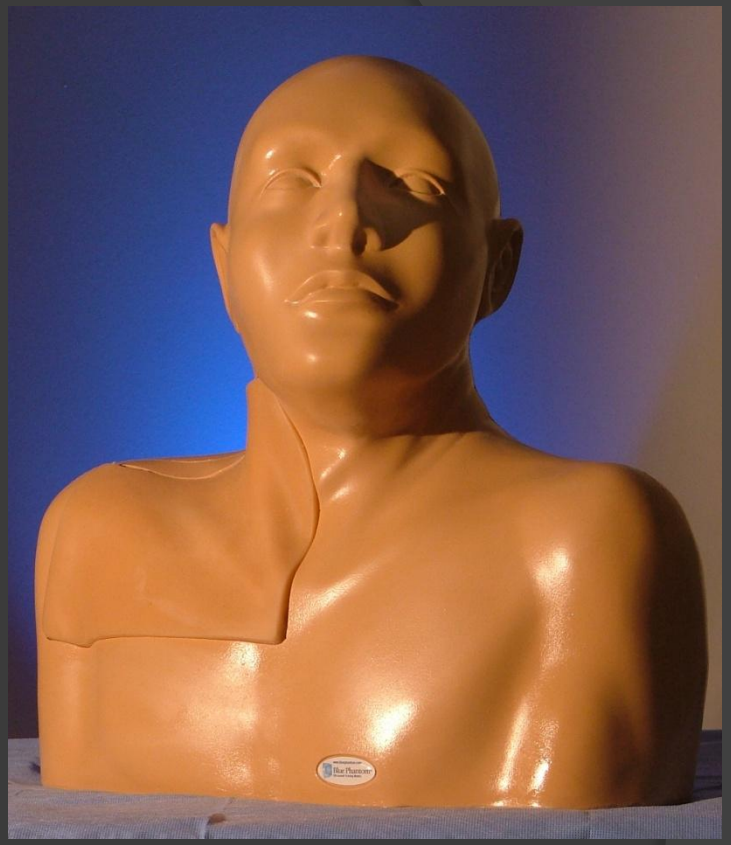
- Training
- Equipment
- Performance
- Anatomic vs ultrasound

The bright idea

- Leader or follower: are others doing this?
- Uniform curriculum to teach procedures
- ABIM list, applicability during residency
- Models, ultrasound machine: who pays?
- Multi-disciplinary group of volunteer faculty

Who wants a new approach?





Procedure service development

- Goals
  - Short-term
  - Long-term
- Logistics
  - Training
  - Equipment & supplies
  - Image archiving
  - Documentation & billing
- Funding
  - Institutional
  - Grants
  - Billing

Procedure service development

- Training
  - Internal and/or external
  - Supervisor & participant
- Data collection & reporting
  - Baseline
  - HIPAA compliant database
  - Paper v electronic
  - Interim analysis
- Standards & guidelines
  - Pre-procedure: consent, labs
  - Equipment & kits
  - Procedural performance
  - Post-procedure: communication & complications

Instructional component

- Baseline medical knowledge evaluation
- Video instruction
- Faculty demonstration
- Practice
- Post-intervention knowledge and skill assessment
- Module evaluation

Experiential learning

- 3 half-days of instruction
- Dedicated 4-week rotation
- Team beeper
- Normal working hours
- Consult info documented
- Triage – fair and equitable distribution
- All info housed in procedural database
- IRB-approved

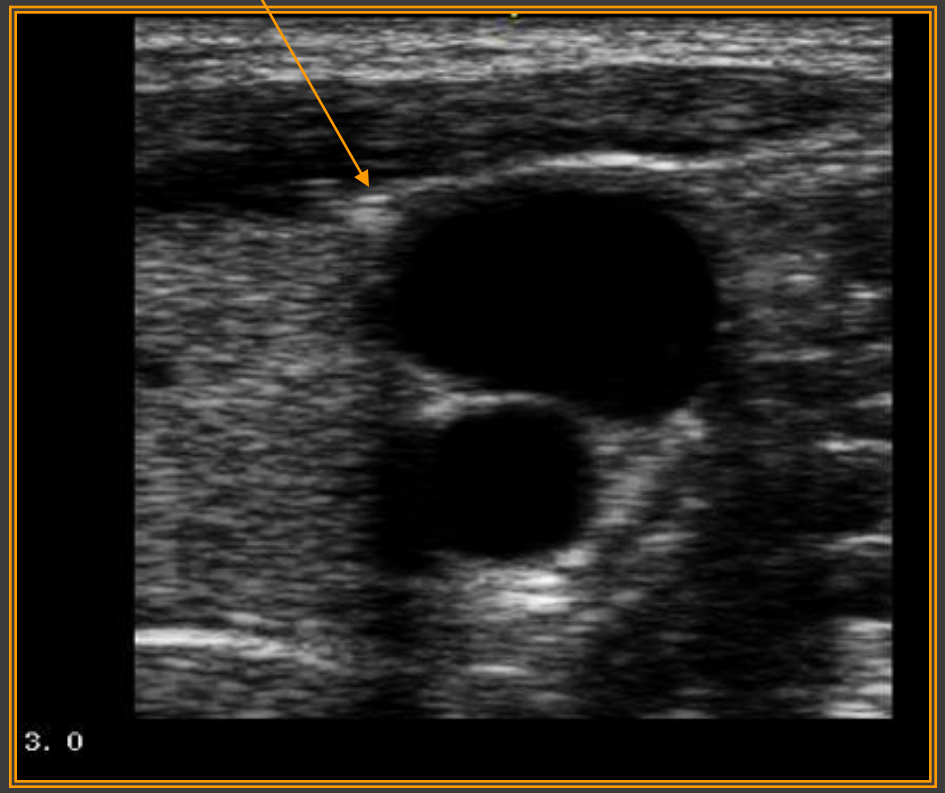
- No location is off limits
- Residents own the procedure
- Informed decision-making process
- Direct supervision by an academic hospitalist:

  EVERY PROCEDURE, EVERY TIME
- Close the communication loop
- Procedural documentation

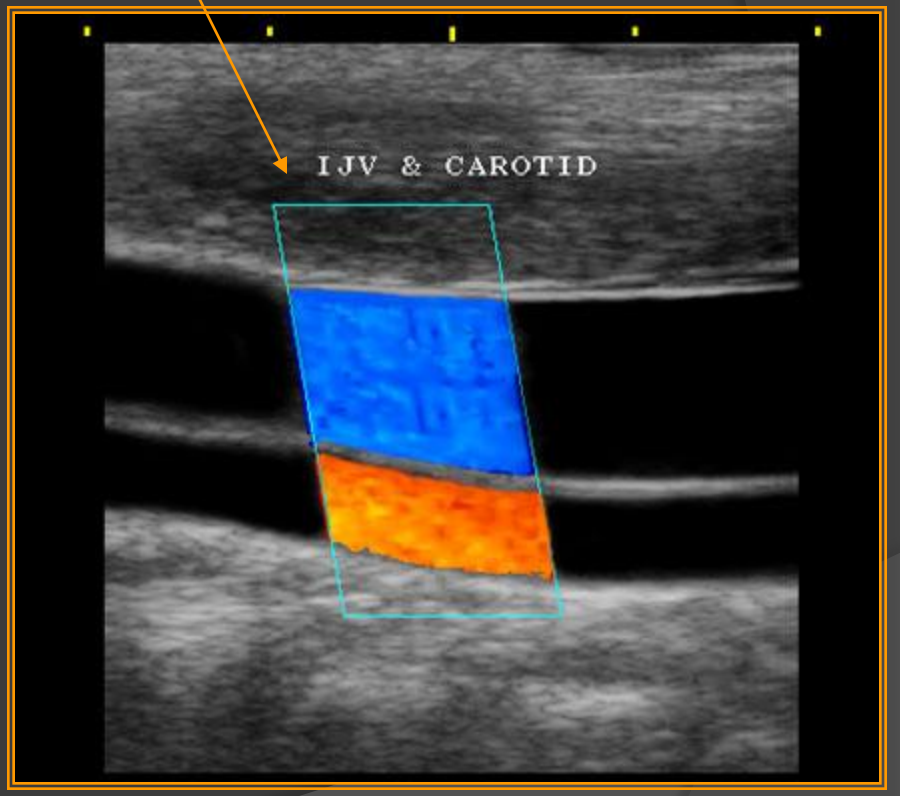
Historical IJ Insertion Method

U/S-guided IJ Insertion Method

Transverse orientation



Longitudinal orientation



Now

CENTURION®

110415

Vascular Access Insertion Kit

Reorder CVI4180

Contents:

1 BOUFFANT
1 MASK
1 PATIENT/FAMILY EDUCATION SHEET
1 CHECKLIST
1 STOP LABEL
1 ABSORBENT TOWEL
1 GOWN
1 CSR WRAP
1 ChloraPrep®[1,3]
1 FULL BODY DRAPE
15 GAUZE SPONGES
1 PROBE COVER KIT
1 LIDOCAINE HCl SOLUTION with AMPULE CRACKER[3]
1 SAFETY NEEDLE, 22G x 1½"[3,4]
1 SYRINGE, 3cc with FILTER STRAW[3]
1 SYRINGE, 5cc[3]
1 SYRINGE, 5cc with SAFETY NEEDLE, 25G x 1"[3]
1 SAFETY SCALPEL
1 LIDOCAINE LABEL
1 NEEDLE RECEPTACLE
1 NEEDLE SECURING DEVICE
1 INNER TRAY
3 PREFILLED SODIUM CHLORIDE SYRINGES
1 SnagFree® NEEDLE HOLDER
1 SUTURE
1 BIOPATCH® Protective Disk with CHG[4]
1 SECUREMENT PATCH
1 SorbaView SHIELD® DRESSING with ADHESIVE FREE ZONE
1 TRAY

LOT 2016020150 2017-09

NOTES: 1) Applicator is sterile. 2) Non-sterile solution. 3) Non-Pyrogenic. 4) Not for use on premature infants.
BIOPATCH® - Registered trademark of Ethicon, Inc.
ChloraPrep® - Registered trademark of CareFusion Corporation or one of its affiliates.
SnagFree® - Registered trademark of Centurion Medical Products Corp. U.S. Patent No. D492,777.
Store between 20-25°C (68-77°F).

STERILE EO | Do not reuse. Single use only. | Do not use if package is open or damaged. | LATEX FREE | Consult instructions for use. | SnagFree®

(01) 1 0653160 28445 1

CAUTION: Federal law (USA) restricts this device to sale by or on the order of a physician.

CENTURION MEDICAL PRODUCTS CORP.
WILLIAMSTON | MI | 48895 | USA | www.centurionmp.com

INFORMATION: 800.248.405

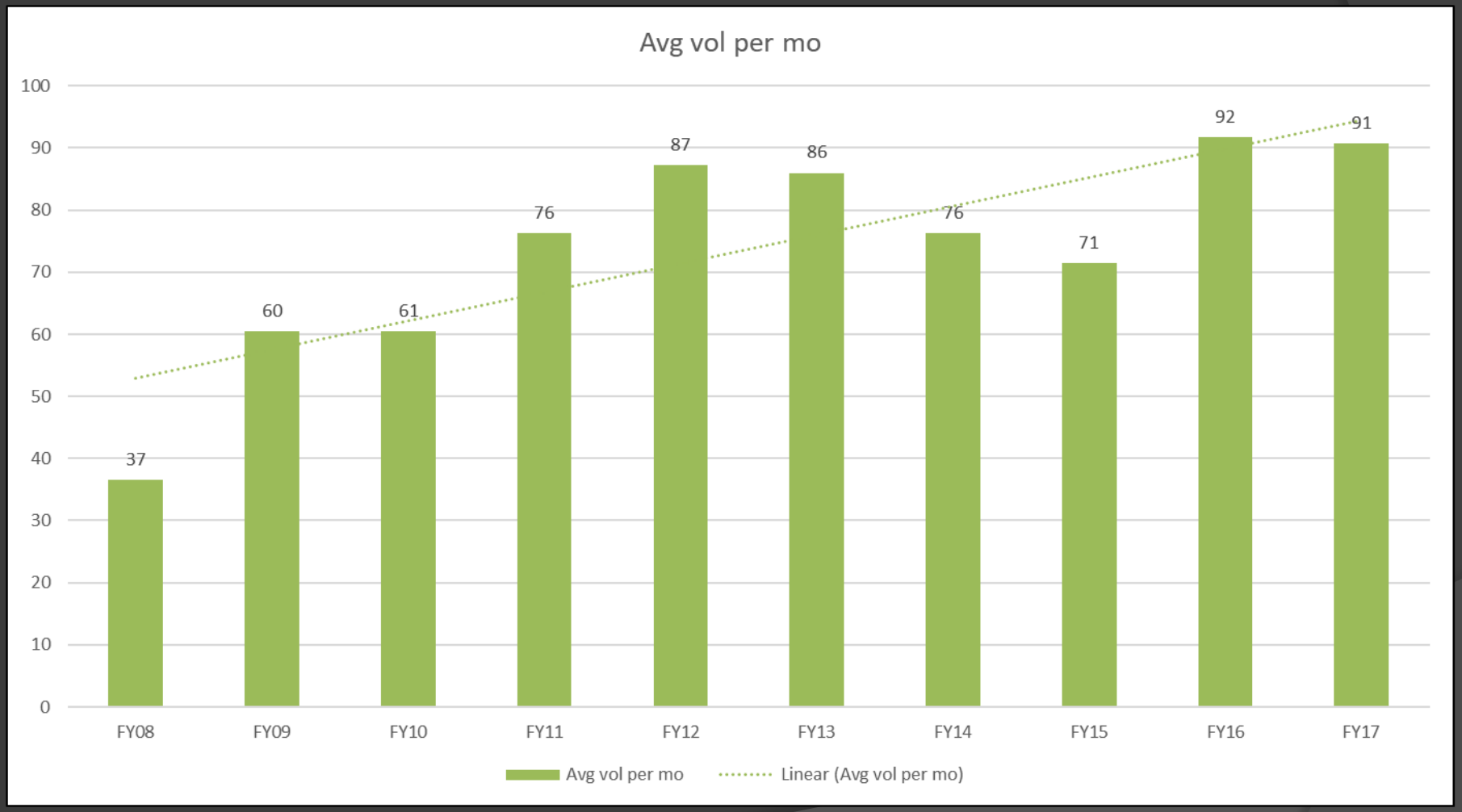
Impact, 2007-18

- Nearly 600 procedure team participants
  - More than 500 residents + 59 students
- Total number of consults
  - Almost 13,000
- Total number from resident-run medical teams
  - More than 3,900
- Others include OB/GYN, ER, ICU and 60 other services

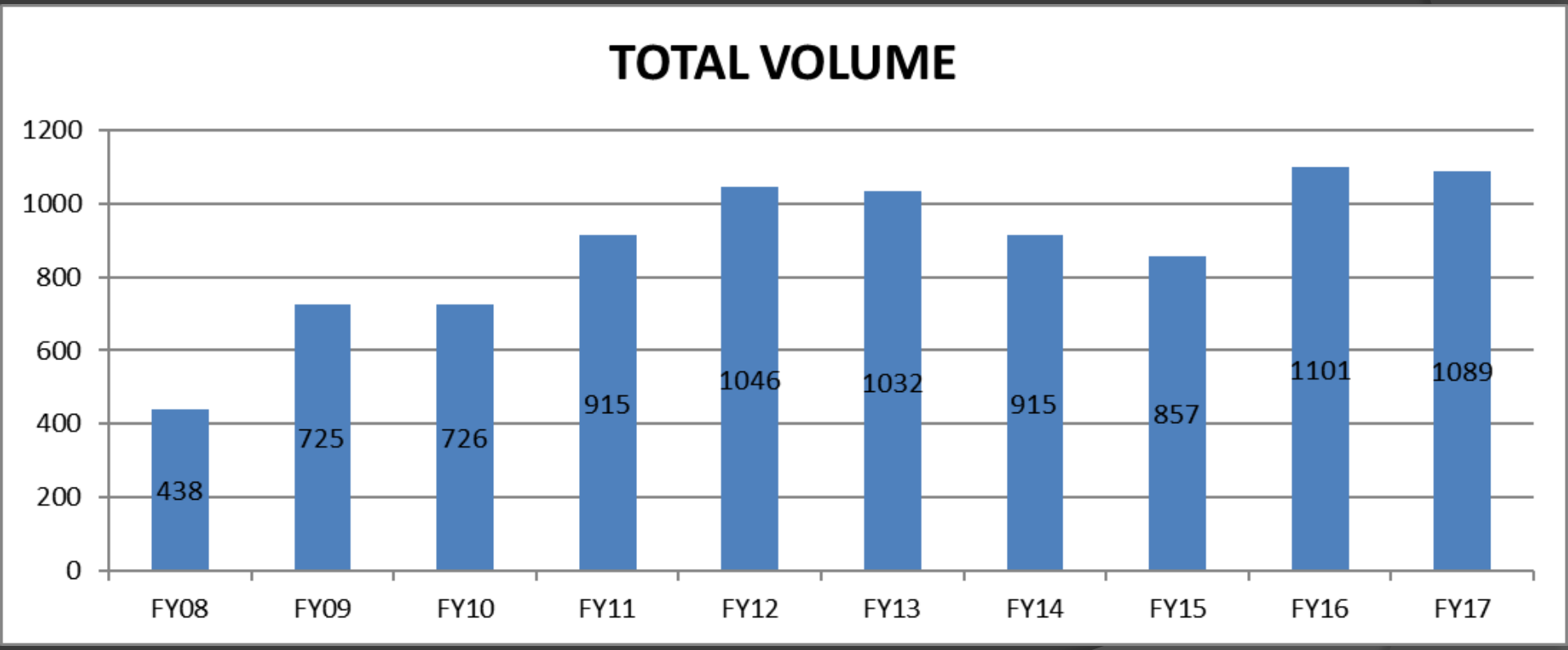
Procedure Totals	Consults (% by procedure)		Attempts (% of Consults Attempted)		Successes (% of Attempts Successful)		% of Consults Completed Successfully
Paracentesis	**4605**	37%	**3399**	74%	**3329**	98%	--> 72.3%
CVC	**2987**	24%	**1894**	63%	**1737**	92%	--> 58.2%
Lumbar Puncture	**2528**	20%	**1837**	73%	**1659**	90%	--> 65.6%
Thoracentesis	**2174**	17%	**1267**	58%	**1202**	95%	--> 55.3%
Arthrocentesis	**123**	1.0%	**68**	55%	**56**	82%	--> 45.5%
Arterial Line	**19**	0.2%	**11**	58%	**11**	100%	--> 57.9%
Total	**12436**	100%	**8476**	68%	**7994**	94%	--> 64.3%

CVC Breakdown:	Attempted (% Breakdown)		Completed	% of Attempts completed
Internal Jugular	**1152**	61%	**1055**	--> 91.6%
Femoral	**628**	33%	**578**	--> 92.0%
Subclavian	**111**	6%	**101**	--> 91.0%
External Jugular	**3**	0.002	**3**	--> 100.0%
Total	**1894**	100%	**1737**	--> 91.7%

TOTAL VOLUME PERFORMED

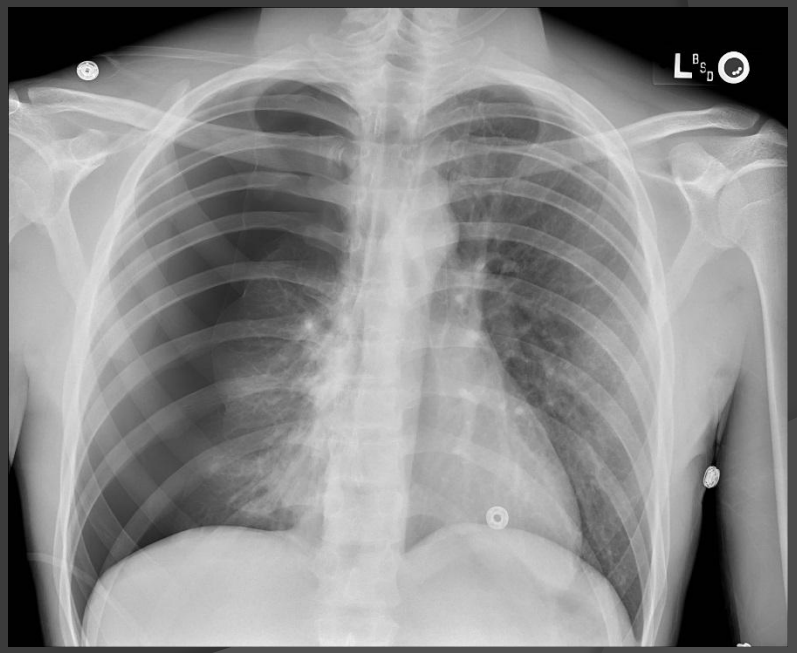


TOTAL VOLUME PERFORMED



Thoracentesis – Iatrogenic pneumothorax

- 4 – 7 excess days in hospital length of stay
- $17,000 - $45,000 in excess cost
- 1% - 14% excess mortality



	Pneumothorax rate, no. (%)	Complicated PNTX rate, no. (%)
Gordon, et al, 2010 meta-analysis (n = 6605)	349 (6.0)	112 (1.7)
Procedure Team, 2007 – 2011 (n = 417)	8 (1.9)	2 (0.05)
JMH total (n = 1515)	82 (5.4)	10 (0.7)
Procedure Team (n=417)	8 (1.9)	2 (0.05)
Non-Proc Team (n = 1098)	74 (6.7)	8 (0.7)

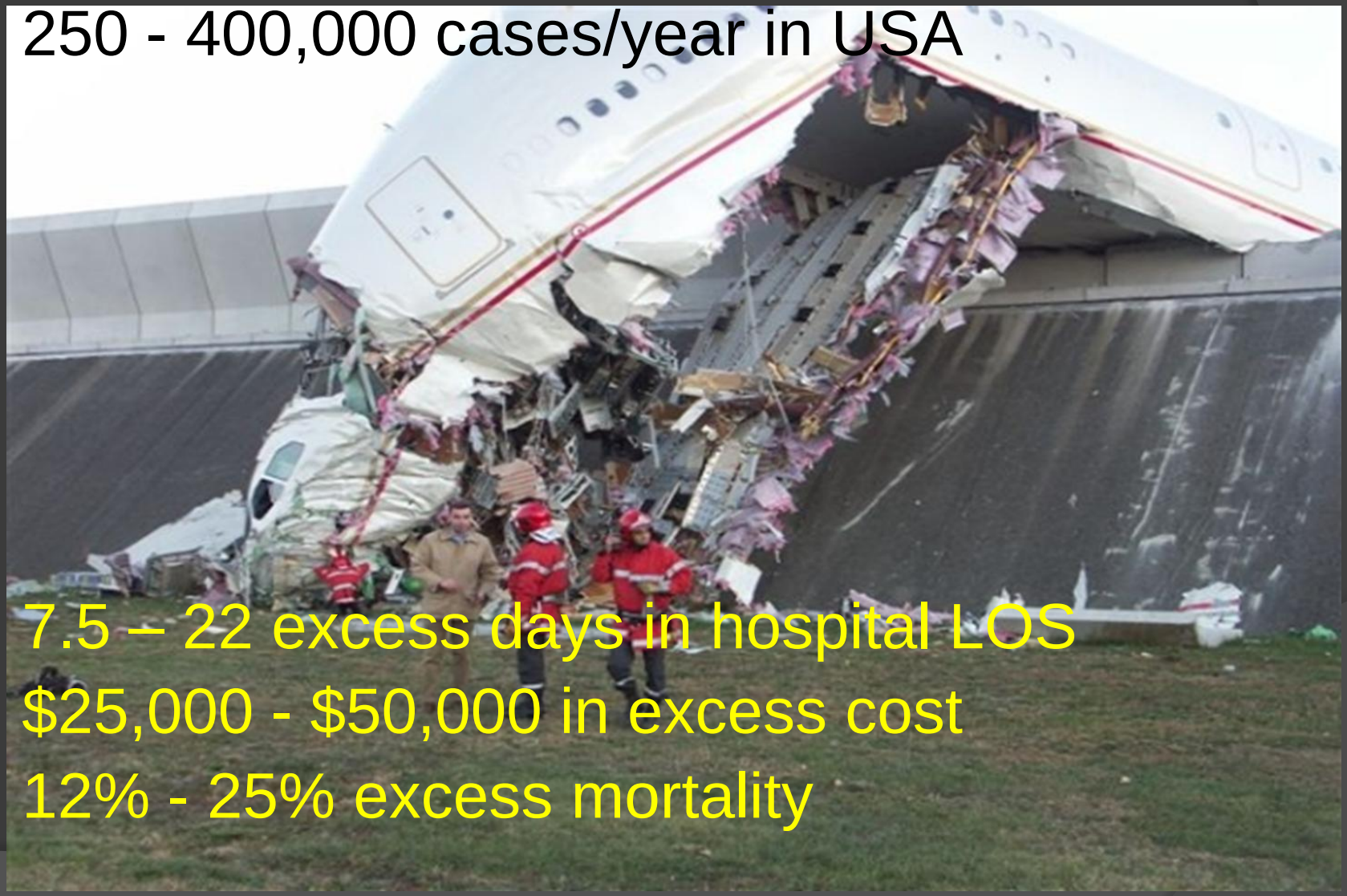
	JMH total PNTX, no. (%); (n = 82)	JMH total non-PNTX, no. (%); (N = 1433)	P value
Male sex	46 (56.1)	846 (59.0)	.60
Caucasian race	56 (70.7)	943 (65.7)	.35
ICU patient location	27 (39.2)	445 (31.1)	.72
Mechanical ventilation	19 (23.2)	300 (20.9)	.63
Loculated effusion	20 (24.4)	286 (20.0)	.33
Experienced operator	4/66 (6.1)	117/1266 (9.2)	.38
Therapeutic thora	70/74 (94.6)	1216/1378 (88.2)	.09
Large needle/cath size	44/59 (74.6)	966/1222 (79.1)	.41
Follow-up thora	33 (40.2)	388 (27.1)	.01

Fiscal impact

- Thoracentesis-induced PNTX ($20K ea.)
  - JMH 07-11, 74/1098 = $1,480,000
  - PT 07-11, 8/417 = $160,000

$1,320,000 potential reduction

Central line-associated bloodstream infection



EBM to Prevent CLABSI

- *Hand Hygiene*: waterless, alcohol-based hand sanitizer or wash hands with soap and water.
- *Insertion site selection*: subclavian preferred in adults for CVC.
- Proper *skin preparation* with chlorhexidine.
- Use *maximal barrier* precautions with full-body sterile drape.
- *Reassess catheter necessity* daily: remove CVC as soon as possible.

Characteristic	Values are expressed in mean ± SD, otherwise specified
Patient, n	673
Age	54.4 (16.5)
Gender, n (%) • Male • Female	 406 (60.3) 267 (39.7)
Length of stay (LOS) (days)	27.1 (35.3)
Catheters, n	781
Site of insertion, n (%) • Femoral (Fem) • Jugular (IJ) • Subclavian (SC)	 267 (34.2) 476 (60.9) 38 (4.9)
Type of Catheter, n (%) • Standard CVC • Hemodialysis catheter	 181 (23.2) 600 (76.8)
Location, n (%) • ICU • Non ICU	 344 (44) 437 (56)
Catheter-days	6154
Duration of catheterization (days) • Overall • Fem/IJ/SC	 7.9 (6.5) 6.5 (5.1)/8.6 (7)/8.4 (7.1)

Characteristics	CLABSI, n	Catheter-days (%)	CLABSI rate	RR (95 % CI)	p
Overall	14	6154	2.28	-	-
Insertion site • Femoral • Jugular • Subclavian	 1 13 0	 1731 (28.1) 4102 (66.7) 321 (5.2)	 0.58 3.17 0	0.14 (0.02-1.04)[a]	0.052
Type of Catheter • Standard CVC • Hemodialysis	 0 14	 1470 (23.9) 4684 (76.1)	 0 2.99	-	0.048
Location • ICU • Non ICU	 5 9	 2979 (48.4) 3175 (51.6)	 3.02 1.57	2.3 (0.77-6.76)[b]	0.20

Below cut-off		Above cut-off	
Number of CLABSI	CLABSI rate	Number of CLABSI	CLABSI rate
Cut-off 2 calendar days			
1	0.16	13	2.28
Cut-off 3 calendar days			
1	0.16	13	2.28
Cut-off 4 calendar days			
3	0.49	11	1.95

Defining competency

- ✓ Minimum post-intervention written test score
- ✓ 100% critical skills checklist score
- ✓ 4 or 5 / 5 self-assessed confidence/capability
- ✓ 5 / 5 faculty assessed confidence/capability

IMPROVED PATIENT OUTCOMES

	All Residents		Residents by Group		n	p-value among groups
		Not Competent (N)	Borderline Competent (B)	Competent (C)		
Number (%)	148	55 (37)	40 (27)	53 (36)		
Resident Characteristics						
Male, No. (%)	73 (49)	25/55 (45)	18/40 (45)	30/53 (57)	148	.42
US medical school, No. (%)	94 (64)	40/55 (73)	23/40 (58)	31/53 (58)	148	.20
PGY2, No. (%)	117 (79)	43/55 (78)	31/40 (78)	43/53 (81)	148	.76
Educational Training Scores						
Pre-test (out of 10)*	6.7 (0.2)	6.6 (0.3)	6.7 (0.3)	6.8 (0.3)	148	.84
Post-test (out of 10)*	8.7 (0.1)	8.5 (0.2)	8.8 (0.2)	8.8 (0.2)	148	.34
Pre-skill (out of 50)*	43.0 (0.5)	41.8 (0.8)	44.3 (0.9)	43.0 (0.8)	111	.14
Post-skill (out of 50)*	45.3 (0.5)	44.5 (0.7)	45.6 (1.0)	46.1 (0.7)	66	.27
Before training*	7.2 (0.4)	6.2 (0.7)	6.6 (0.8)	8.7 (0.7)	119	.05
Attempted during training*	4.3 (0.2)	3.5 (0.3)	4.1 (0.3)	5.4 (0.3)	148	<.001
Total experience*	11.2 (0.5)	9.4 (0.8)	10.6 (1.0)	13.7 (0.9)	119	.002

*mean, (SE)

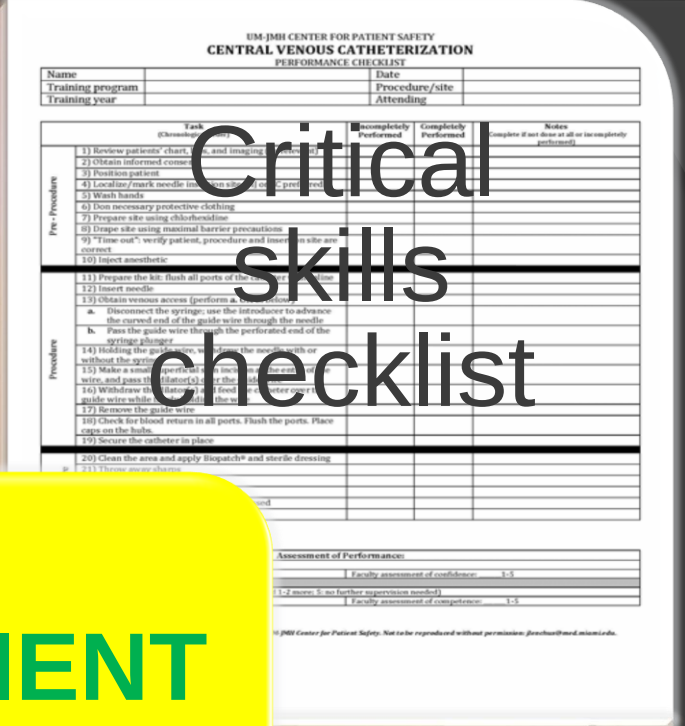
	All Residents		Residents by Group		n	p-value among groups	p-value between groups		
		Not Competent (N)	Borderline Competent (B)	Competent (C)			N vs B	B vs C	N vs C
Number (%)	148	55 (37)	40 (27)	53 (36)					
Completed procedures*	3.8 (0.2)	3.1 (0.3)	3.7 (0.3)	4.8 (0.3)	147	<.001	.14	.009	<.001
Completion rate, % (SE)	93 (1)	91 (2)	96 (2)	93 (2)	147	.30	.12	.40	.46
Multiple-attempt procedures (≥3)*	0.7 (0.1)	0.9 (0.1)	0.4 (0.2)	0.7 (0.1)	147	.04	.01	.12	.29
Multiple-attempt rate, % (SE)	18 (2)	26 (3)	9 (4)	15 (3)	147	.002	.001	.23	.02
Complications*	0.2 (0.04)	0.3 (0.1)	0.2 (0.1)	0.2 (0.1)	147	.42	.30	.94	.23
Complication rate, % (SE)	6 (1)	10 (2)	6 (2)	3 (2)	147	.08	.19	.45	.03
Successful procedures*	3.2 (0.2)	2.2 (0.2)	3.2 (0.3)	4.2 (0.3)	147	<.001	.009	.01	<.001
Composite success rate, % (SE)	76 (2)	65 (3)	84 (4)	80 (4)	147	.001	<.001	.42	.003

*mean, (SE)

Pearls and Pitfalls

- Obtain baseline institutional data
- Administrative buy-in
- Task trainers + ultrasound = $$$
- Recruit faculty to train and supervise
- Standardize faculty training and grading
- Start low, go slow
- Collect data
- Interim analysis

Simulation-based procedural instruction


UM-JMH CENTER FOR PATIENT SAFETY

CENTRAL VENOUS CATHETERIZATION

PERFORMANCE CHECKLIST

Name		Date	
Training program		Procedure/site	
Training year		Attending	

Task (Chronological order)	Incompletely Performed	Completely Performed	Notes (Complete if not done at all or incompletely performed)
Pre- Procedure			
1) Review patients' chart, [illegible], and imaging			
2) Obtain informed consent			
3) Position patient			
4) Localize/mark needle insertion site, prepare [illegible]			
5) Wash hands			
6) Don necessary protective clothing			
7) Prepare site using chlorhexidine			
8) Drape site using maximal barrier precautions			
9) "Time out": verify patient, procedure and insertion site are correct			
10) Inject anesthetic			
Procedure			
11) Prepare the kit: flush all ports of the [illegible]			
12) Insert needle			
13) Obtain venous access (perform a. [illegible] below)			
a. Disconnect the syringe; use the introducer to advance the curved end of the guide wire through the needle			
b. Pass the guide wire through the perforated end of the syringe plunger			
14) Holding the guide wire, [illegible] the needle with or without the syringe			
15) Make a small [illegible] at insertion site, if [illegible] wire, and pass the dilator(s) over the [illegible]			
16) Withdraw the dilator(s) and feed the catheter over the guide wire while [illegible] the wire			
17) Remove the guide wire			
18) Check for blood return in all ports. Flush the ports. Place caps on the hubs.			
19) Secure the catheter in place			
20) Clean the area and apply Biopatch® and sterile dressing			
21) Throw away sharps			
[illegible]			

Assessment of Performance:

Faculty assessment of confidence: ____ 1-5

(1-2 more; 5: no further supervision needed)

Faculty assessment of competence: ____ 1-5

Critical skills checklist

PATIENT SAFETY

Bedside ultrasound

Direct attending supervision

THANK YOU

Joshua D. Lenchus, DO, RPh, FACP, SFHM
jlenchus@yahoo.com
Cel: 954-817-5684