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Mastery Learning and Translational Science

William C. McGaghie, PhD

Financial Relationships

- Taylor & Francis Group
- John Wiley Publishing
- Northwestern University

Premise

Only innovators are asked to present evidence that novel [educational] approaches are effective.

Status quo never ***requires supporting data!***

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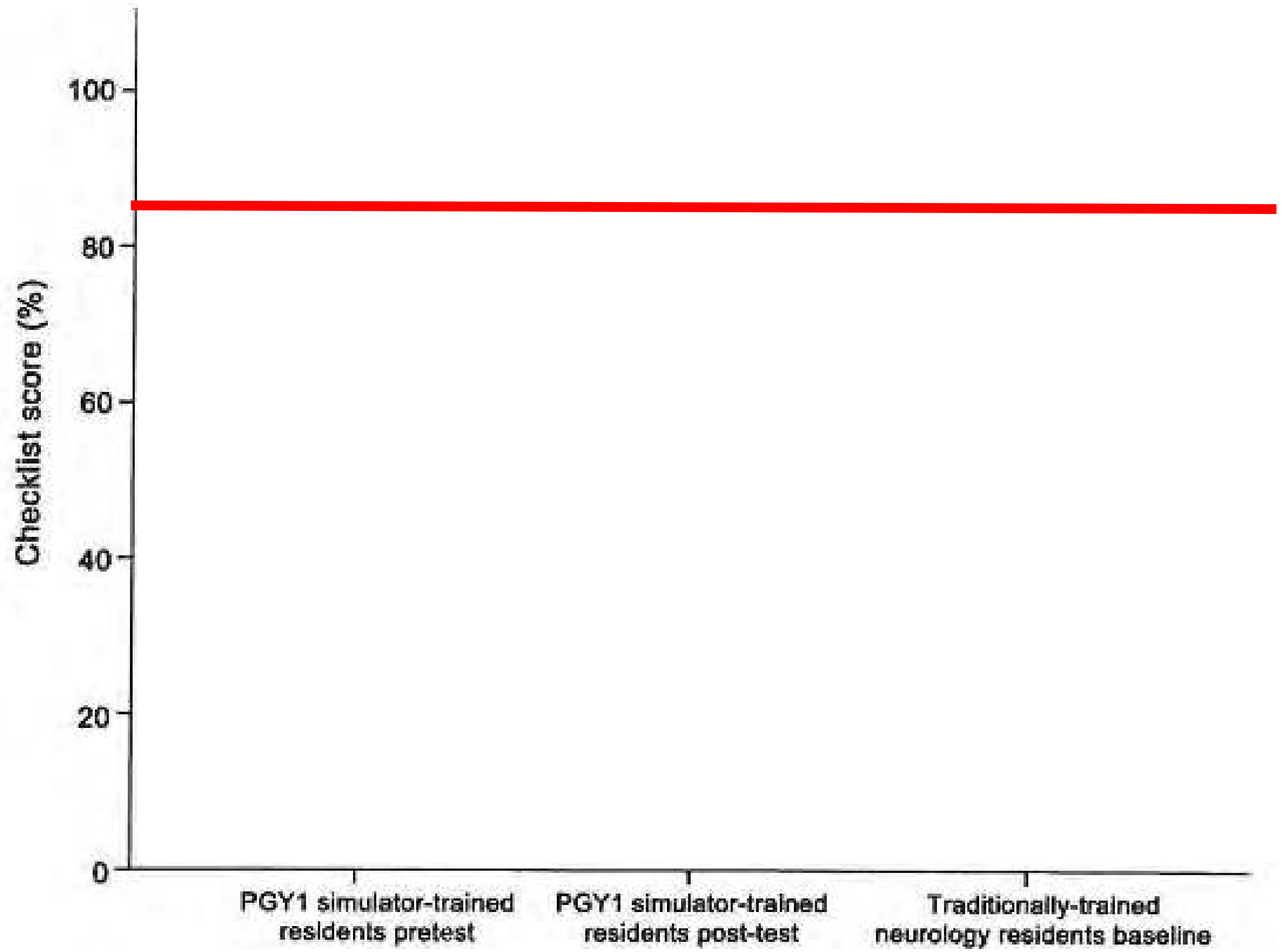
Goals of this Presentation

1. Transfer of training pathway from the simulation education lab to patient care settings
2. Address translational science
3. Features of rigorous simulation-based medical education (SBME)
4. Interpret data from selected research studies on SBME transfer of training
5. Unexpected collateral effects



Source: Barsuk JH et al. Neurology 2012; 79(2): 132-37

Obsolete Clinical Education

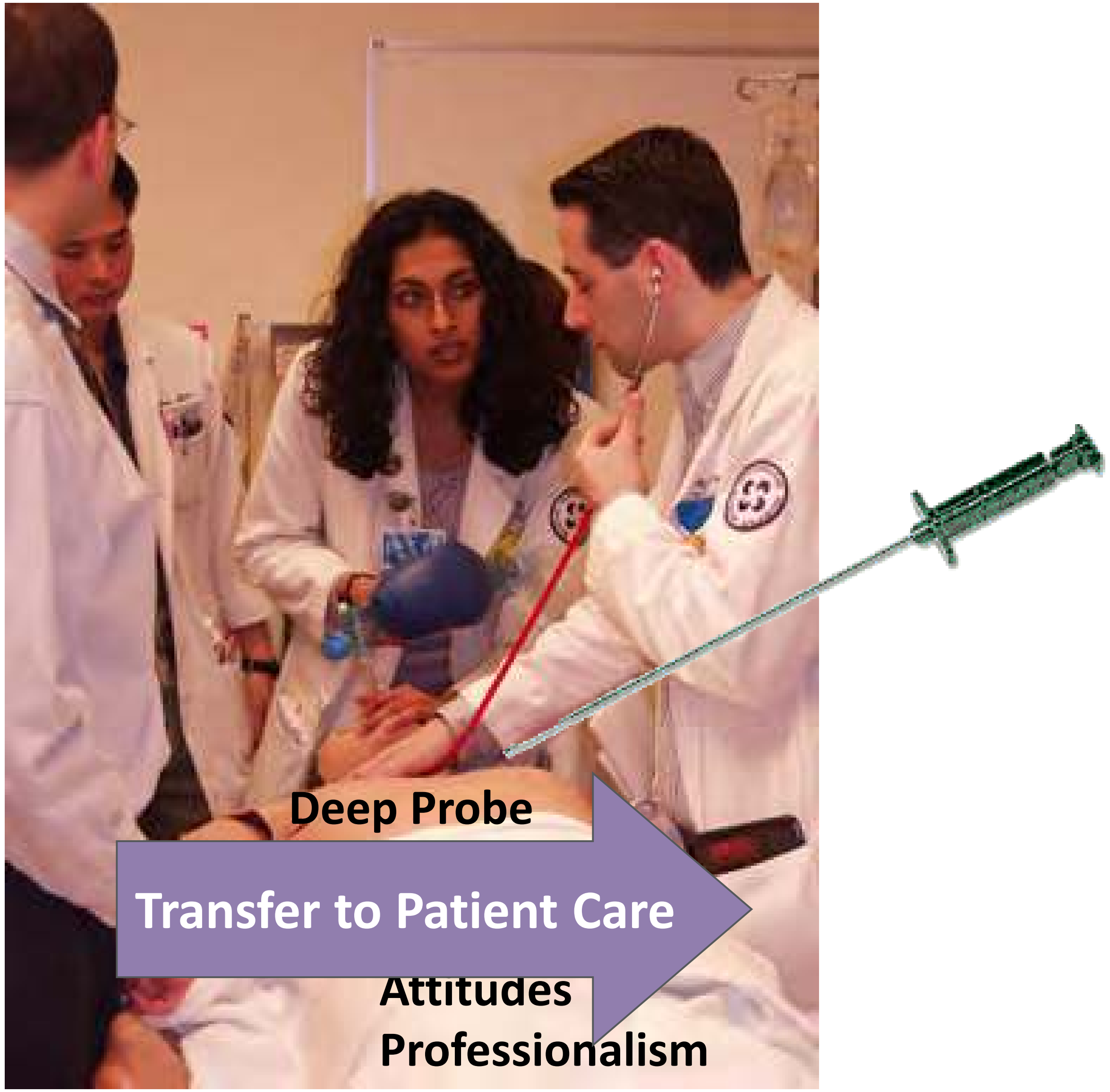
"The Barsuk et al. study is clearly a wake-up call for all of us who were trained in the era of 'see one, do one, teach one'—the so-called 'apprenticeship' model of clinical training. The old training methods are no longer enough to ensure the best education, and thus the best care for patients."

Nathan & Kincaid, *Neurology* (2012)

Goal: Educate Superb Clinicians

- Effective & Safe
- Quality Patient Care
- Good Patient Outcomes

Simulation Lab



COMMENTARY

MEDICAL EDUCATION

Medical Education Research As Translational Science

William C. McGaghie

Published 17 February 2010; Volume 2 Issue 19 19cm8

Medical Education Research as Translational Science

Contributions of *powerful medical education interventions* to T1 – T4 outcomes

	Level of Translation
Focus	
Increased or Improved	
Target Groups	
Setting	

McGaghie 2010; Barsuk & Szmuilowicz, 2015

Key SBME Research Concepts

Mastery Learning

Deliberate Practice

Mastery Learning Bundle

Feature

1. Baseline, i.e., diagnostic testing;
2. Clear learning objectives, units ordered by difficulty;
3. Educational activities (e.g., deliberate skills practice) focused on objectives;
4. Minimum passing ***mastery*** standard (MPS) for each unit;
5. Formative testing + feedback → ***mastery*** of each unit;
6. Advancement if performance ≥ MPS; or
7. Continued practice or study until MPS is reached

Time can ***vary,*** outcomes are ***uniform***

McGaghie et al., Chest 2009


Deliberate Practice
Mastery Learning

Deliberate Practice (DP)

Features

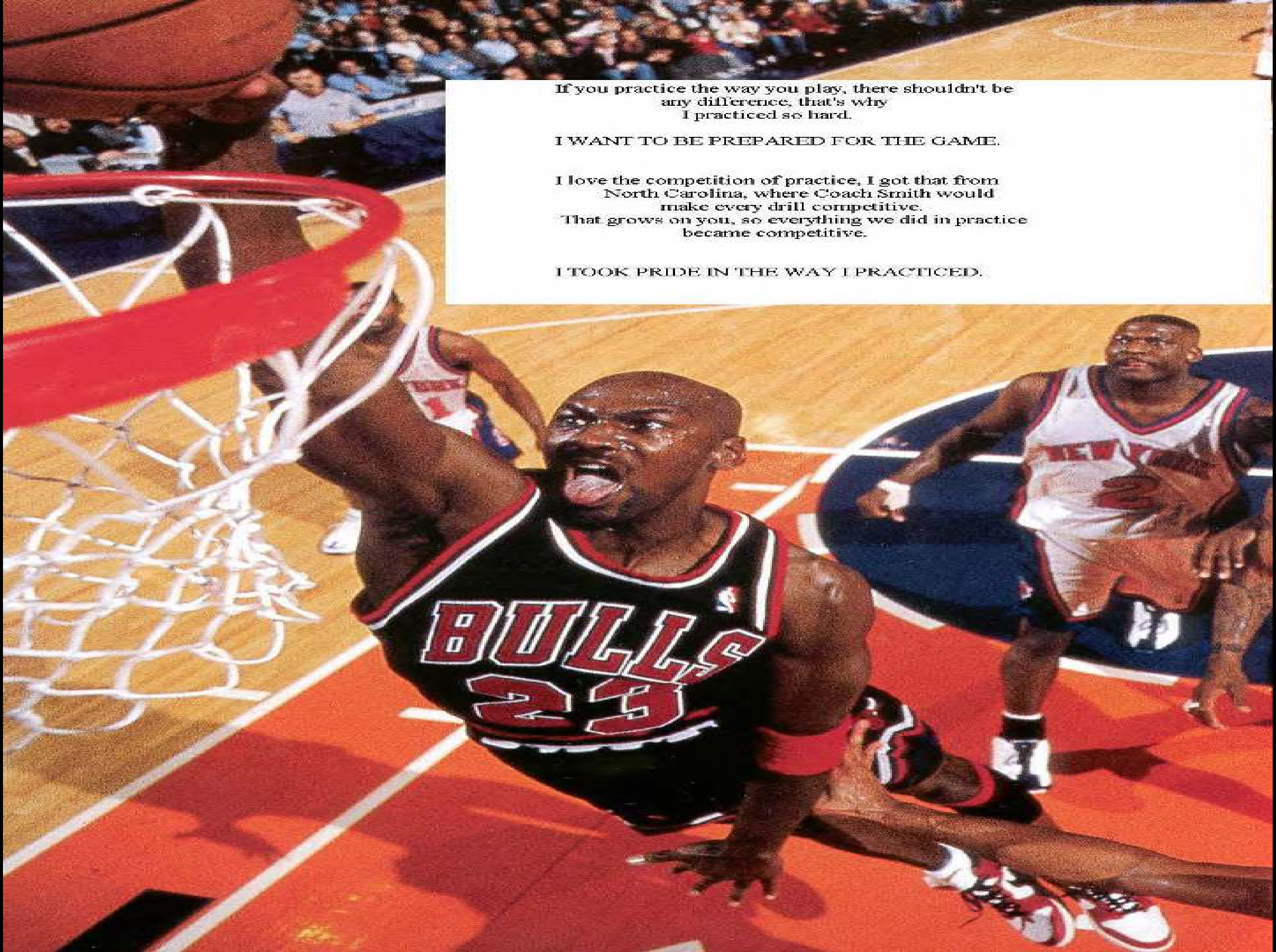
1. Highly motivated learners with good concentration;
2. Engagement with a well-defined learning objective or task; at an
3. Appropriate level of difficulty; with
4. Focused, *repetitive practice*; that leads to
5. Rigorous, precise measurements; that yield
6. Informative feedback from educational sources (e.g., simulators, teachers); and where
7. Trainees also monitor their learning experiences and correct strategies, errors, and levels of understanding, engage in more DP; and continue with
8. Evaluation to reach a *mastery* standard; and then
9. Advance to another task or unit
10. Goal: *constant improvement*

If you practice the way you play, there shouldn't be any difference, that's why I practiced so hard.

I WANT TO BE PREPARED FOR THE GAME.

I love the competition of practice, I got that from North Carolina, where Coach Smith would make every drill competitive. That grows on you, so everything we did in practice became competitive.

I TOOK PRIDE IN THE WAY I PRACTICED.



"The acquisition of skills requires a regular environment, an adequate opportunity to practice, and rapid and unequivocal feedback about the correctness of thoughts and actions. When these conditions are fulfilled, skill eventually develops, and the intuitive judgments and choices that quickly come to mind will mostly be accurate."

Daniel Kahneman [Nobel Laureate]

Thinking, Fast and Slow

SBME Translational Science (TS)

Example Program

CVC T1 → T2 → T3 → T4 (costs, retention, collateral effects)

Thematic → Sustained → Cumulative

SBME-TS Research Example

Central Lines

1. **CVC Placement in Simulation Lab (T1)**
2. **CVC Insertion → ↓ Complications in MICU (T2)**
3. **CVC Insertion → ↓ CLABSI in MICU (T3)**
4. **CVC Insertion → ↑ Cost Savings (T4-$)**
5. **CVC Insertion Skills Retention (T4-R)**
6. **Unexpected collateral effects (T4-CE)**

(T1 Outcomes)

ORIGINAL RESEARCH

Use of Simulation-Based Mastery Learning to Improve the Quality of Central Venous Catheter Placement in a Medical Intensive Care Unit

Jeffrey H. Barsuk, MD[1]
William C. McGaghie, PhD[2]
Elaine R. Cohen, BA[1]
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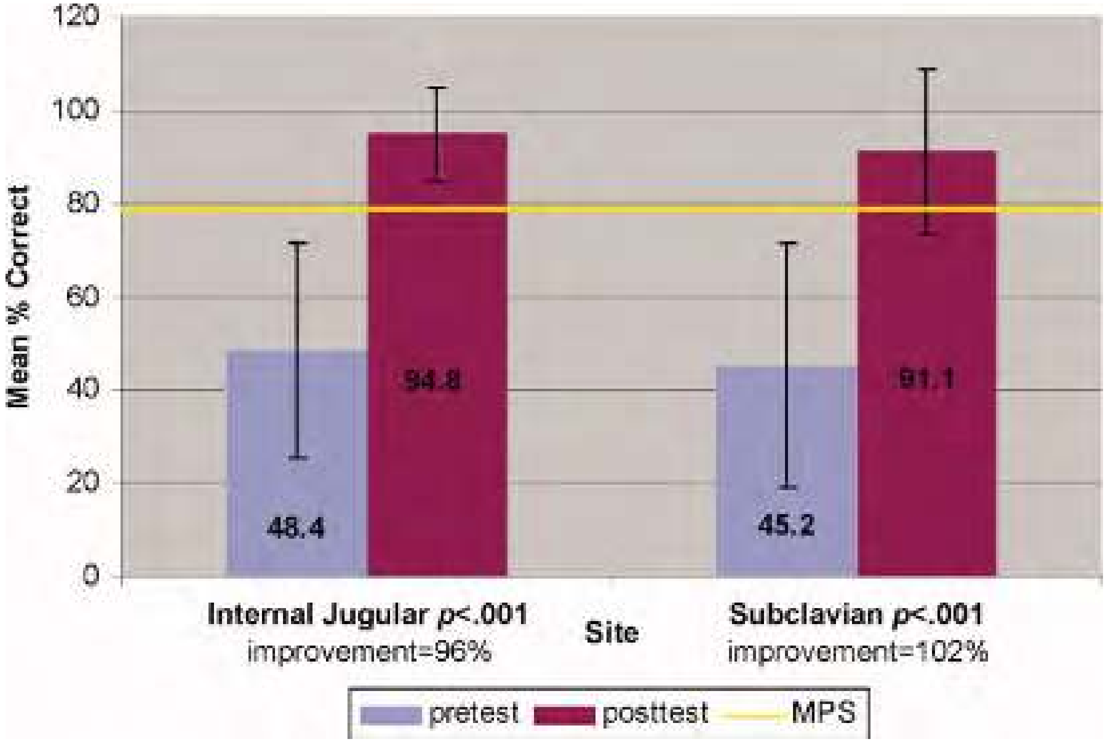
J Hosp Med. 2009; 4: 397-403

(T1 Outcomes)



120
100
80
60
40
20
0
Mean % Correct
48.4
94.8
45.2
91.1
Internal Jugular p<.001
improvement=96%
Site
Subclavian p<.001
improvement=102%
pretest
posttest
MPS

(T2 Outcomes)

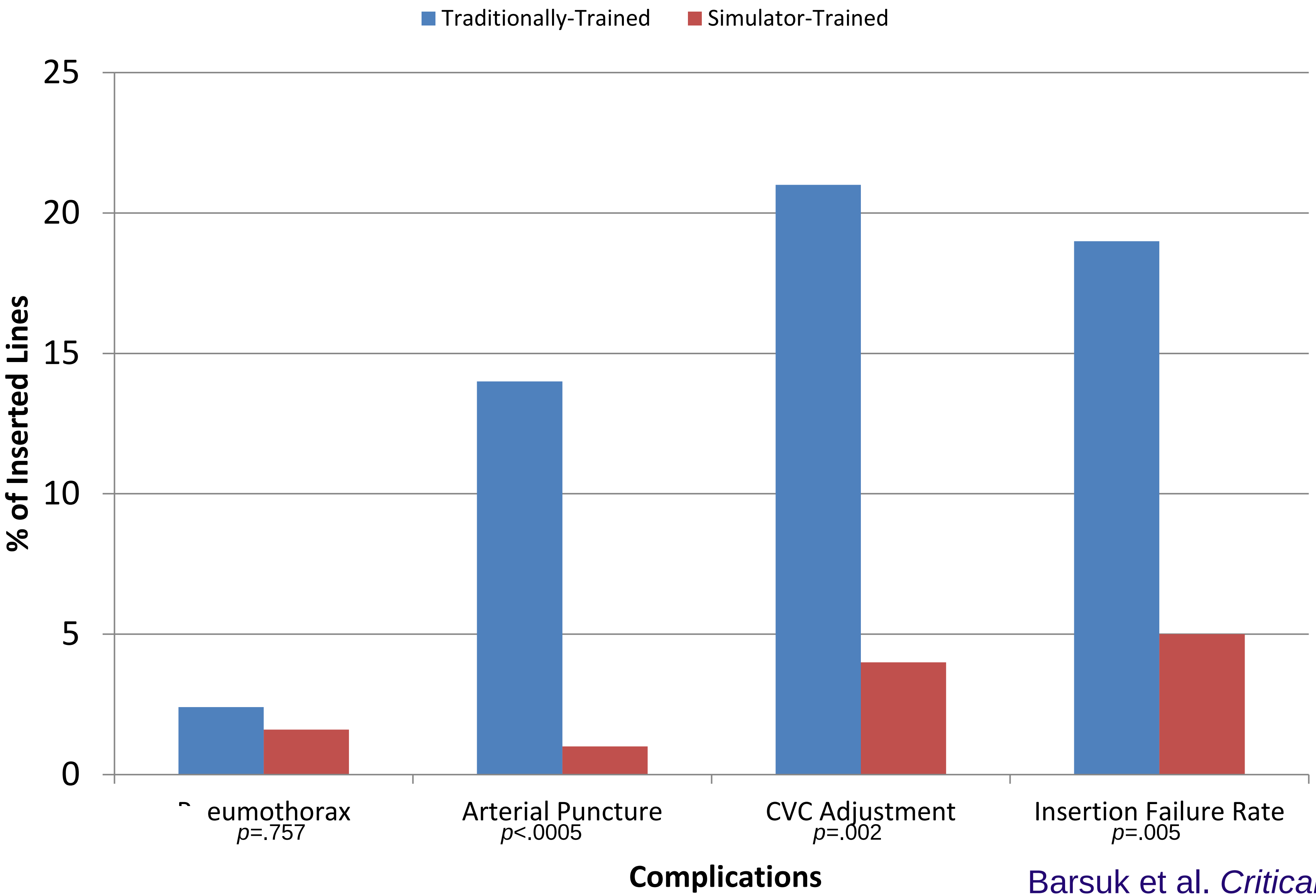
Simulation-based mastery learning reduces complications during central venous catheter insertion in a medical intensive care unit*

Jeffrey H. Barsuk, MD; William C. McGaghie, PhD; Elaine R. Cohen, BA; Kevin J. O'Leary, MD; Diane B. Wayne, MD

Critical Care Medicine. 37(10):2697-2701, October 2009.
doi: 10.1097/CCM.0b013e3181a57bc1

Wolters Kluwer Health | OvidSP

Clinical Outcomes: Complications (T2 Outcomes)



Barsuk et al. *Critical Care Medicine* 2009

(T3 Outcomes)

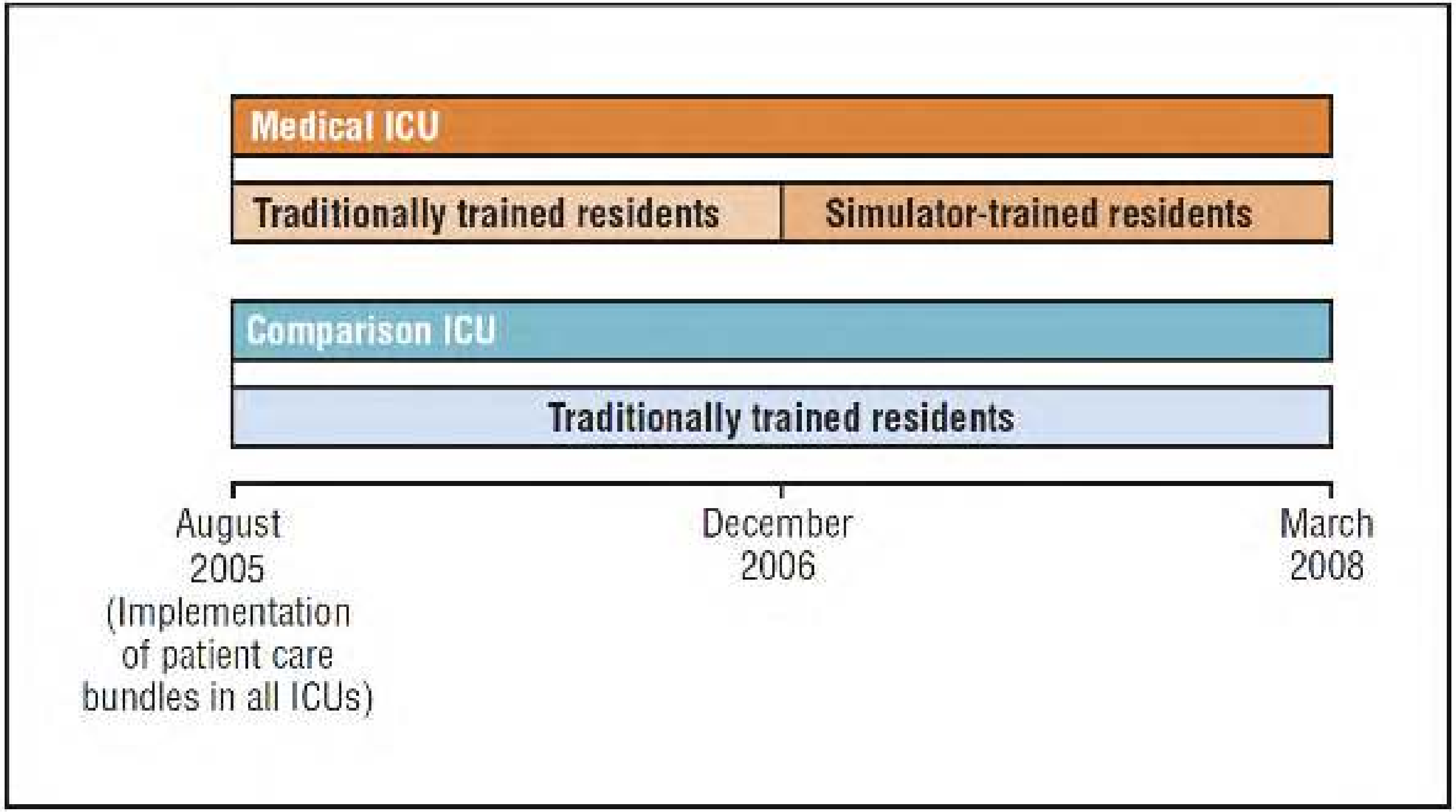
ORIGINAL INVESTIGATION

Use of Simulation-Based Education to Reduce Catheter-Related Bloodstream Infections

Jeffrey H. Barsuk, MD; Elaine R. Cohen, BA; Joe Feinglass, PhD; William C. McGaghie, PhD; Diane B. Wayne, MD

***Arch Intern Med*. 2009; 169: 1420-23.**

Timeline of residents rotating in the medical intensive care unit (ICU) and a comparison ICU

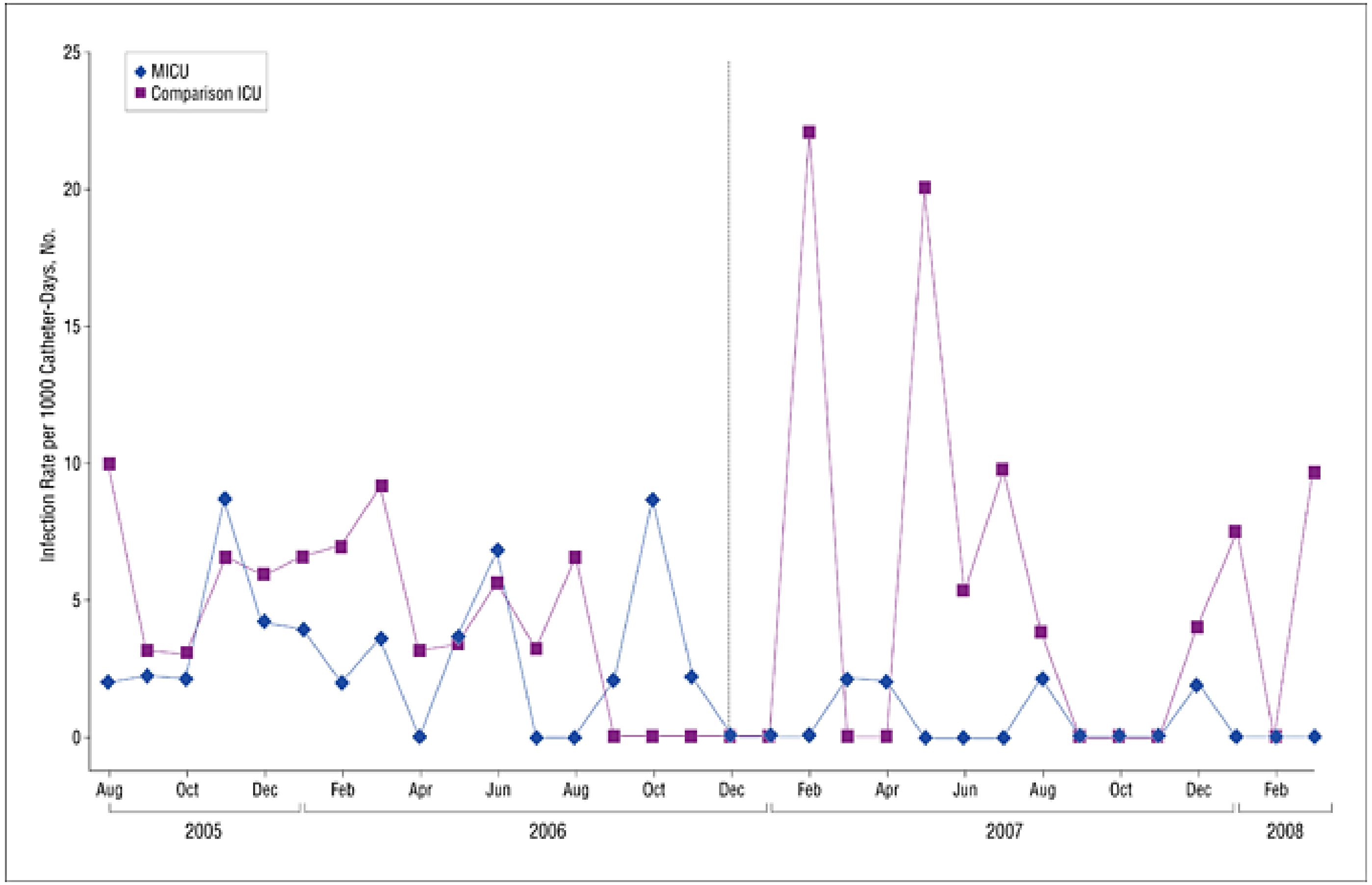


ARCHIVES OF INTERNAL MEDICINE

Barsuk, J. H. et al. Arch Intern Med 2009;169:1420-1423.

Monthly central line-associated bloodstream infection rates in a medical intensive care unit (MICU) and a comparison intensive care unit (ICU) before and after a simulation-based educational intervention in the MICU

(T3 Outcomes)



Barsuk, J. H. et al. Arch Intern Med 2009;169:1420-1423.

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85% ↓ in CLABSI

ARCHIVES OF INTERNAL MEDICINE

Cost Savings

(T4-$ Outcomes)

- Cost savings from reduced catheter-related bloodstream infection after simulation-based education for residents in a medical intensive care unit.

7:1 ROI

Cohen et al. *Simul Healthc* (2010)

- Cost savings of performing paracentesis procedures at the bedside after simulation-based education

IR vs. Bedside

5 times higher cost

↑ platelet transfusions

↑ fresh frozen plasma transfusions

Barsuk et al. *Simul Healthc* (2014)

(T4-R Outcomes)

Long-Term Retention of Central Venous Catheter Insertion Skills After Simulation-Based Mastery Learning

Jeffrey H. Barsuk, Elaine R. Cohen, William C. McGaghie, and Diane B. Wayne

Abstract

Background
Simulation-based mastery learning (SBML) of central venous catheter (CVC) insertion improves trainee skill and patient care. How long skills are retained is unknown.

Method
This is a prospective cohort study. Subjects completed SBML and were required to meet or exceed a minimum passing score (MPS) for CVC insertion on a posttest. Skills were retested 6 and 12 months later and compared with posttest results to assess skill retention.

Results
Forty-nine of 61 (80.3%) subjects completed follow-up testing. Although performance declined from posttest where 100% met the MPS for CVC insertion, 82.4% to 87.1% of trainees passed the exam and maintained their high performance up to one year after training.

Conclusions
Skills acquired from SBML were substantially retained during one year. Individual performance cannot be predicted, so programs should use periodic testing and refresher training to ensure competence.

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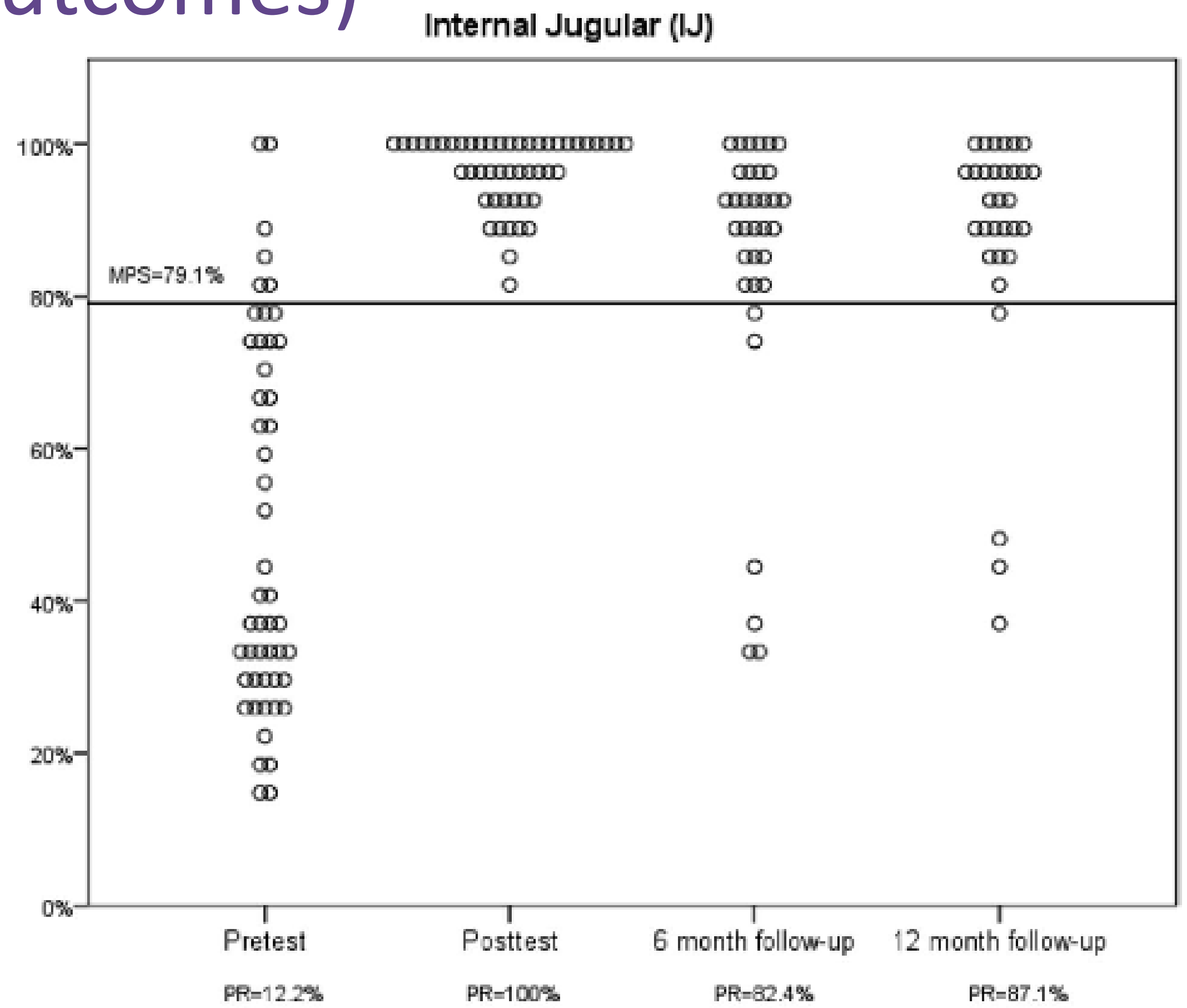
Academic Medicine 2010; 85(10, Suppl.):S9-S12

(T4-R Outcomes)



(T4-R Outcomes)

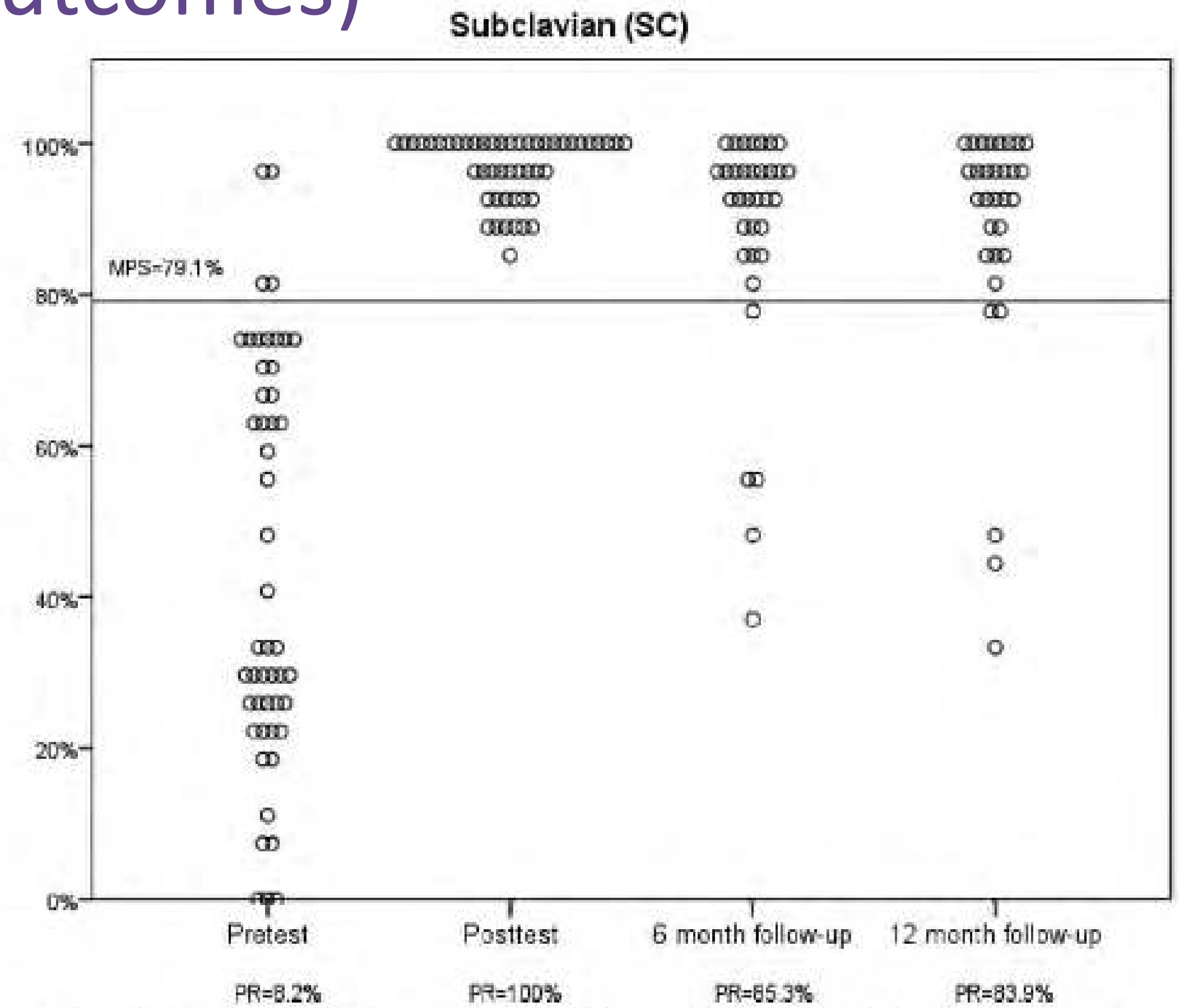


Figure 1 Individual residents' internal jugular (IJ) and subclavian (SC) checklist scores at pretest, posttest, six-month, and one-year follow-up. Pass rate (PR) is reported for each interval, and minimum passing score (MPS) is indicated for each checklist.

(T4-CE Outcomes)

Unexpected Collateral Effects of Simulation-Based Medical Education

Jeffrey H. Barsuk, MD, MS, Elaine R. Cohen, Joe Feinglass, PhD,
William C. McGaghie, PhD, and Diane B. Wayne, MD

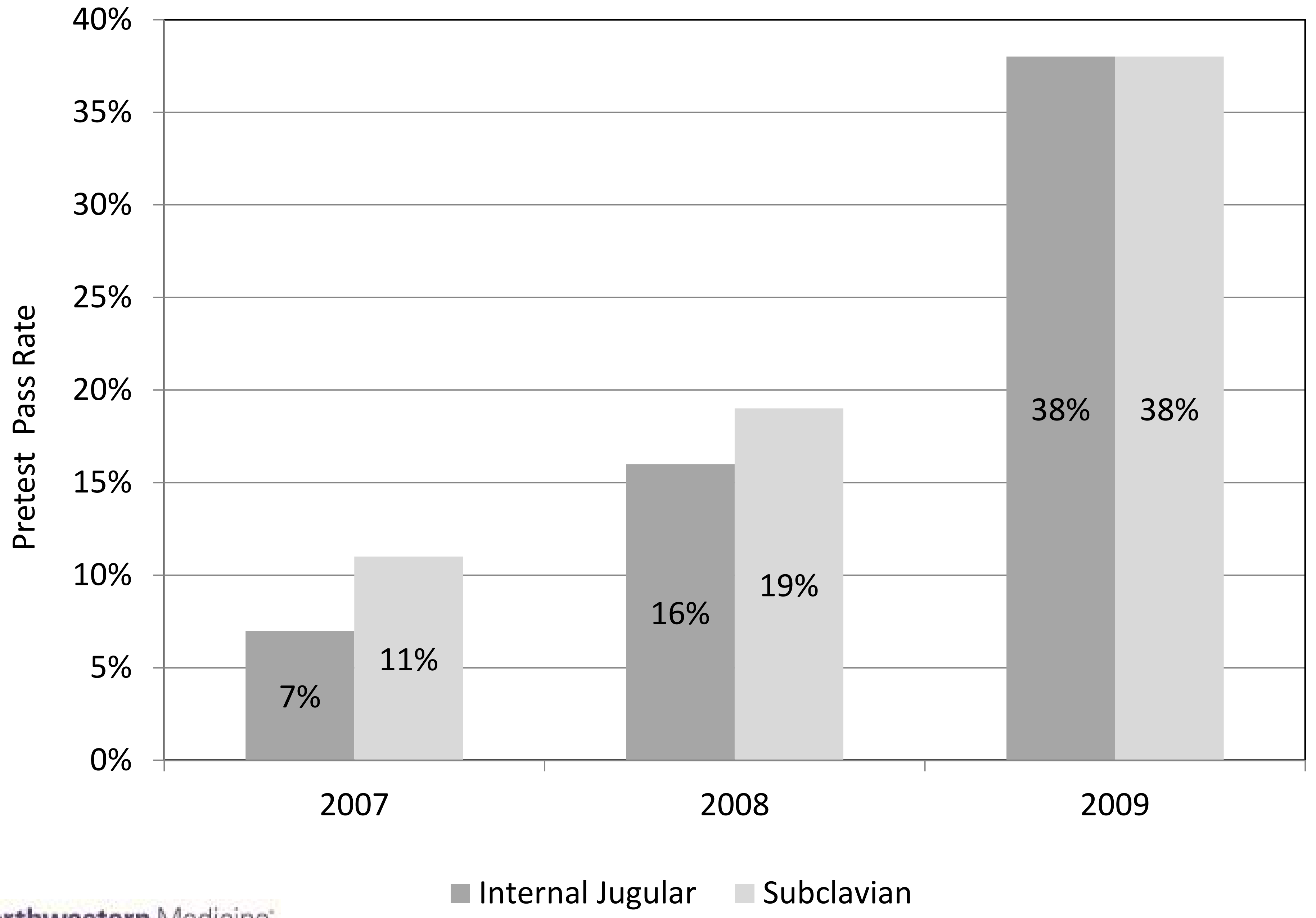
Abstract

Purpose
Internal medicine residents who complete simulation-based education (SBE) in central venous catheter (CVC) insertion acquire improved skills that yield better patient care outcomes. The collateral effects of SBE on the skills of residents who have not yet experienced SBE are unknown.

Method
In this retrospective, observational study, the authors used a checklist to test the internal jugular and subclavian CVC insertion skills of 102 Northwestern University second- and third-year internal medicine residents before they received simulation training. The authors compared, across consecutive academic years (2007–2008, 2008–2009, 2009–2010), mean pretraining scores and the percent of trainees who met or surpassed a minimum passing score (MPS).

Results
Mean internal jugular pretest scores improved from 46.7% (standard deviation = 20.8%) in 2007 to 55.7% (±22.5%) in 2008 and 70.8% (±22.4%) in 2009 ($P < .001$). Mean subclavian pretest scores changed from 48.3% (±25.5%) in 2007 to 45.6% (±31.0%) in 2008 and 63.6% (±27.3%) in 2009 ($P = .04$). The percentage of residents who met or surpassed the MPS before training for internal jugular insertion was 7% in 2007, 16% in 2008, and 38% in 2009 ($P = .004$); for subclavian insertion, the percentage was 11% in 2007, 19% in 2008, and 38% in 2009 ($P = .028$).

Conclusions
SBE for senior residents had an effect on junior trainees, as evidenced by pretraining CVC insertion skill improvement across three consecutive years. SBE for a targeted group of residents has implications for skill acquisition among other trainees.



p=.004 *p*=.028

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(T4-CE Outcomes)

APPLIED RESEARCH

Raising the Bar: Reassessing Standards for Procedural Competence

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ROUTLEDGE
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Simulation Transfer to Practice – Other Examples

Study	Findings
Sroka et al. Am J Surg. (2010)	Training on the FLS simulator led to **improved OR performance in lap cholecystectomy compared to controls**
Draycott et al. BJOG (2006)	S-B obstetric team training **significantly reduces incidence of low infant APGAR scores and infant brain injury**
Butter et al. J Gen Intern Med. (2010)	S-B mastery learning **improves medical students' cardiac auscultation skills that transfer to actual patients**
Cook et al. Acad Med. (2013)	Systematic review and meta-analysis show **mastery learning has large effects on skill acquisition and moderate effects on patient outcomes**