Competency-Based Medical Education: Origins and Prospects

William C. McGaghie, PhD
No Conflict of Interest
Competency-Based Medical Education: Origins and Prospects

Five Questions
What is medical competence?
What are the origins of mastery learning?
Why is this an issue in 2014?
What are the answers in medical education?
What are the barriers?
What is medical competence?

ACGME competencies

CanMEDS framework

Scottish Doctor learning outcomes
Developing competence as a physician

- Practice-based Learning & Improvement
- Patient Care
- Professionalism
- Interpersonal & Communication Skills
- Medical Knowledge
- Systems-based Practice
The Scottish Doctor

Learning Outcomes

The doctor as a professional

What the doctor is able to do

The doctor approaches their practice

What should the doctor do

The doctor does not approach their practice

The doctor approaches their practice

Medical Information

Patient Management

Patient Investigation

Clinical Skills

Communication

Practical Procedures

Health promotion and disease prevention

Role of the doctor within the healthcare service

Personal development

Basic, social and clinical sciences and underlying principles

Decision making skills and clinical reasoning and judgement

Attitudes, ethical understanding and legal responsibilities
COMPETENCY-BASED
CURRICULUM DEVELOPMENT
IN MEDICAL EDUCATION:
An Introduction

W. C. MCCAGHIE, C. E. MILLER,
A. W. SAJJID & T. V. TELDER

WORLD HEALTH ORGANIZATION
GENEVA
Competency-Based Curriculum (1978)

Differs from subject centered and integrated course models in three ways:

1. Grounded in functions (competencies) required for medical practice in a specific setting

2. Mastery learning (high achievement for all, time can vary)

3. Education is an experiment (learning and teaching are hypotheses subject to test)
“A competency-based curriculum in any setting assumes that the many roles and functions involved in the doctor’s work can be defined and clearly expressed.”

“Careful delineation of these components of medical practice is the first and most critical step in designing a competency-based curriculum.”
Latest Incarnation

AAMC

Entrustable Professional Activities

“... a set of activities that entering residents should be expected (entrusted) to perform on day one of residency without direct supervision.”
Core Entrustable Professional Activities for Entering Residency (CEPAER)

Association of American Medical Colleges
Washington, DC
Medical Education Cluster
November 2013
The Core EPAs for Entering Residency

1. History & physical  
2. Prioritized ddx  
3. Recommend and interpret dx and screening tests  
4. Enter patient orders/prescriptions  
5. Document clinical encounter  
6. Patient presentation  
7. Form clinical questions and retrieve evidence  
8. Give or receive a patient handover  
9. Interprofessional teamwork  
10. Recognize patient needing urgent/emergent care  
11. Obtain informed consent for tests and procedures  
12. Perform procedures  
13. ID system failures and contribute to safety
EPA: Entrustable Professional Activity
DOC: Domain of Competence
C: Competency
M: Milestone
Narrative description of a pre-entrustable learner

Narrative description of the entrustable learner
Take Home Messages

• Implementation of the Core EPAs is an invitation, not a mandate

• These EPAs represent a “floor” not a “ceiling”

• EPAs are units of work, competencies are abilities of individuals

• Entrustment decisions require frequent direct observation in the work place

• Help-seeking behavior and trustworthiness are foundational to all EPAs
What are the origins of mastery learning?

- Carroll, Keller, Block & Bloom
- Carroll, A model of school learning
- Block, *Mastery Learning*
A model of school learning

John B. Carroll
Harvard University

“Good-Bye, Teacher…”¹
Fred S. Keller
Arizona State University²

Mastery Learning

James H. Block and Robert B. Burns
University of California, Santa Barbara
1976
Carroll JB. A model of school learning
Teachers College Record 1963; 64: 723-733

Time Needed in Learning

Aptitude
Ability to Understand Instruction
Quality of Instruction

Time Spent in Learning
Time Allowed for Learning (Opportunity)
Perseverance

\[
\text{Degree of Learning} = f \left( \frac{\text{Time actually spent}}{\text{Time needed}} \right)
\]
Mastery Learning
Theory and Practice

Edited by James H. Block

With selected papers by
Peter W. Airasian
Benjamin S. Bloom
John B. Carroll
Mastery Learning

Features
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 → *mastery* of each unit;
6. Advancement if performance ≥ MPS; or
7. Continued practice or study until MPS is reached
8. Time *varies*, outcomes are *uniform*

McGaghie et al., Chest 2009
Why is This an Issue in 2014?

• Great conceptual advancements (EPAs, DOC, competencies, milestones)
• Great at measuring acquired knowledge
• But, obsolete model of clinical medical education and outcome assessment
• Using 19\textsuperscript{th} century ideas, knowledge, and technology to educate 21\textsuperscript{st} century physicians
AEQUANIMITAS

With other Addresses to Medical Students, Nurses and Practitioners of Medicine

By

Sir WILLIAM OSLER, Bt., M.D., F.R.S.
Late Regius Professor of Medicine, Oxford
Honorary Professor of Medicine, Johns Hopkins University

THIRD EDITION

PHILADELPHIA
P. BLAKISTON'S SON & CO., Inc.
1899

XVI

THE HOSPITAL AS A COLLEGE

THE last quarter of the last century saw many remarkable changes and reformations, among which in far-reaching general importance not one is to be compared with the reform, or rather revolution, in the teaching of the science and art of medicine. Whether the conscience of the professors at last awoke, and felt the pricking of remorse, or whether the change, as is more likely, was only part of that larger movement toward larger events in the midst of which we are to-day, need not be here discussed. The improvement has been in three directions: in demanding of the student a better general education; in lengthening the period of professional study; and in substituting laboratories for lecture rooms—that is to say, in the replacement of theoretical by practical teaching. The problem before us as teachers may be very briefly stated: to give to our students an education of such a character that they can become sensible practitioners—the destiny of seven-eighths of them. Toward this end are all our endowments, our multiplying laboratories, our complicated curricula, our palatial buildings. In the four years' course a division is very properly made between the preparatory or scientific branches and the practical; the former are taught in the school or college, the latter in the hospital. Not that there is any essential difference; there may be as

1 Academy of Medicine, New York, 1866.
Osler (1903) The hospital as a college . . .
“natural method of teaching”

[Medical education] “Starts with the patient, continues with the patient, ends with the patient”

- Clinical curriculum = patients seen
- No standardization
- Passive educational model
- No rigorous personnel outcome measurement in clinical years (clinical ratings, sources of bias)
Osler model

Current system of clinical medical education is broken, esp. when we measure educational outcomes with rigor
Examples

- Mangione studies (1990s) *Annals of Internal Medicine, JAMA, AJRCCM*
- Resident’s review course (2002) *Teaching and Learning in Medicine*
- Bell et al. (2009) *Annals of Surgery*
- Cohen et al. (2013) *Academic Medicine*
- Barsuk et al. (2012) *Neurology*
ACADEMIA AND CLINIC

The Teaching and Practice of Cardiac Auscultation during Internal Medicine and Cardiology Training
A Nationwide Survey
Salvatore Mangione, MD; Linda Z. Nieman, PhD; Edward Grecozy, PhD; and Donald Kaye, MD

Cardiac Auscultatory Skills of Internal Medicine and Family Practice Trainees
A Comparison of Diagnostic Proficiency
Salvatore Mangione, MD; Linda Z. Nieman, PhD
JAMA. 1997;278:717-722

Pulmonary Auscultatory Skills During Training in Internal Medicine and Family Practice

Salvatore Mangione and Linda Z. Nieman
Center for Research in Medical Education, Jefferson Medical College, Philadelphia, Pennsylvania; and Department of Family Practice and Community Medicine, University of Texas, Houston, Texas
Effectiveness of a Cardiology Review Course for Internal Medicine Residents Using Simulation Technology and Deliberate Practice

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Office of Medical Education and Faculty Development
Northwestern University
The Feinberg School of Medicine
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Center for Research in Medical Education
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Department of Medical Education
Duke University Medical Center
Durham, North Carolina, USA

Ian R. Hart
University of Ottawa
Ontario, Canada

Ronald M. Harden
Centre for Medical Education
University of Dundee
Dundee, Scotland, United Kingdom

Background: Objective evaluations of residents' clinical skills reveal serious deficits. Purpose: To develop, implement, and evaluate outcomes from a review course in cardiology bedside skills for internal medicine residents.

Methods: We used a 1-group pretest-posttest design with historical comparisons. The study was conducted at the University of Miami School of Medicine as part of the internal medicine residency program from July 1999 to June 2000. A total of 67 2nd- and 3rd-year medicine residents received an educational intervention involving deliberate practice using simulation technology. A total of 135 4th-year medical students in one intervention and one comparison group (n = 53) served as historical comparisons. Outcome measures were a reliable computer-delivered pretest and posttest that evaluate cardiology bedside skills.

Results: Residents who received the review course and medical students who received a comparable educational intervention showed large and statistically significant pretest-to-posttest improvement in bedside skills. These 2 groups are also significantly and substantially different at posttest from a comparison group of 4th-year medical students that did not receive a specific educational intervention.

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We are indebted to Steve Mackwell, Ph.D., and Jerry A. Colliver, Ph.D., for assistance with the data analysis and to Michael S. Gordon, M.D., Ph.D., Director, University of Miami Center for Research in Medical Education and to John Clarkson, M.D., Dean, University of Miami School of Medicine for administrative leadership in medical education.
Surgical Experience

- 254 general surgery residency programs in the U.S. as of 2006
- 300 operations graded A, B, or C
- A = 121: graduating general surgery residents should be competent to perform independently
- Graduating 2005 residents (n = 1,022)
  - 18/121 more than 10 times
  - 83/121 less than 5 times
  - 31/121 less than once
  - 63/121 mode experience = 0

*Significant variation between residents in operative experience for specific procedures*
Intern “Boot Camp”

Mastery Outcomes

Recognition of physical examination findings (cardiac auscultation)

Performance of procedures (paracentesis, lumbar puncture)

Management of critically ill patients (ICU skills)

Communication with patients (code status discussion)

No relationship between CSE scores and age, gender, prior experience, self-confidence, or USMLE Step 1 and Step 2 scores
Mastery Learning of Lumbar Puncture Skills

Clinical skills examination (checklist) pre-and final posttest performance of 58 first-year simulator-trained internal medicine residents and baseline performance of 36 traditionally trained neurology residents. Three internal medicine residents failed to meet the minimum passing score (MPS) at initial post-testing. PGY – postgraduate year.

<table>
<thead>
<tr>
<th>Checklist skill item</th>
<th>PGY1 simulator-trained residents (n = 56), n (%)</th>
<th>Traditionally trained neurology residents (n = 36), n (%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed consent obtained</td>
<td>51 (87.0)</td>
<td>15 (41.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
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<tr>
<td>Risks</td>
<td></td>
<td></td>
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<tr>
<td>Consent given</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash hands</td>
<td>52 (96.6)</td>
<td>13 (36.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Call &quot;time out&quot;</td>
<td>56 (96.6)</td>
<td>6 (16.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Properly position the patient</td>
<td>57 (98.3)</td>
<td>30 (83.3)</td>
<td>0.007</td>
</tr>
<tr>
<td>Demonstrate knowledge of correct anatomic location for procedure</td>
<td>52 (96.7)</td>
<td>17 (47.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Put on sterile gloves</td>
<td>58 (100)</td>
<td>33 (91.7)</td>
<td>0.025</td>
</tr>
<tr>
<td>Properly set up equipment</td>
<td>56 (96.6)</td>
<td>19 (52.8)</td>
<td>&lt;0.001</td>
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<tr>
<td>Manometer</td>
<td></td>
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<tr>
<td>Tubes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean the skin with Betadine x .3 (do not use chlorhexidine)</td>
<td>56 (96.6)</td>
<td>25 (69.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Drape the patient</td>
<td>57 (98.3)</td>
<td>36 (100)</td>
<td>0.43</td>
</tr>
<tr>
<td>Use 1% lidocaine to form a wheal at intended site</td>
<td>55 (94.8)</td>
<td>23 (63.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anesthetize deeper structures (larger needle)</td>
<td>54 (93.1)</td>
<td>23 (63.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Insert spinal needle advancing toward umbilicus</td>
<td>58 (100)</td>
<td>30 (83.3)</td>
<td>0.001</td>
</tr>
<tr>
<td>Bevel must be in correct direction</td>
<td>57 (98.3)</td>
<td>30 (83.3)</td>
<td>0.007</td>
</tr>
<tr>
<td>Slowly advance the needle with periodic checking for CSF removal of styliet until space entered</td>
<td>54 (93.1)</td>
<td>27 (75.0)</td>
<td>0.013</td>
</tr>
<tr>
<td>Measure opening pressure</td>
<td>56 (96.6)</td>
<td>23 (63.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Collect fluid in proper tubes</td>
<td>55 (94.8)</td>
<td>28 (77.8)</td>
<td>0.012</td>
</tr>
<tr>
<td>Remove the needle after the styliet is replaced</td>
<td>50 (86.2)</td>
<td>30 (83.3)</td>
<td>0.70</td>
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<tr>
<td>Place dressing</td>
<td>54 (93.1)</td>
<td>32 (88.9)</td>
<td>0.48</td>
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<tr>
<td>Notify the nurse the procedure is done; give postprocedure orders</td>
<td>55 (96.5)</td>
<td>13 (36.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>List routine tests to be ordered (must include glucose, cell count, protein, Gram stain, culture)</td>
<td>52 (92.7)</td>
<td>15 (41.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Maintain sterile technique</td>
<td>53 (93.0)</td>
<td>27 (75.0)</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Abbreviations: Abbreviation: PGY = postgraduate year.
What are the answers in clinical medical education?

- Simulation-based mastery learning (SBML) with deliberate practice (DP)
- Controlled, laboratory setting
- *Rigorous measurement and feedback*
- Translational, downstream outcomes
- *Data: tool, not a weapon*
- Complements clinical experience
Does Simulation-Based Medical Education With Deliberate Practice Yield Better Results Than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence

William C. McGaghie, PhD, S. Barry Issenberg, MD, Elaine R. Cohen, Jeffrey H. Barsuk, MD, and Diane B. Wayne, MD
Simulation-based Medical Education with Deliberate Practice Yields Better Results than Traditional Clinical Education: A Meta-Analytic Comparative Review of the Evidence

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Competency Assessed</th>
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<tr>
<td><strong>Randomized Trials</strong></td>
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<tr>
<td>3. Andreatta, et al, 2006</td>
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<td>Laparoscopic skills</td>
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<td><strong>Cohort Studies</strong></td>
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<td>7. Issenberg, et al, 2002</td>
<td>98</td>
<td>Cardiology skills</td>
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<td><strong>Case-Control Studies</strong></td>
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<td><strong>Pre-Post Baseline Studies</strong></td>
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<td>Research Design and Study</td>
<td>Correlation</td>
<td>Lower Limit</td>
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<tr>
<td>1. Wayne et al, 2005</td>
<td>0.81</td>
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<tr>
<td>2. Ahlberg et al, 2007</td>
<td>0.80</td>
<td>0.56</td>
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<tr>
<td>3. Andreatta et al, 2006</td>
<td>0.67</td>
<td>0.40</td>
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<td>4. Korndorffer et al, 2005</td>
<td>0.62</td>
<td>0.29</td>
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<tr>
<td>5. Korndorffer et al, 2005</td>
<td>0.52</td>
<td>0.17</td>
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<tr>
<td>6. Van Sickle et al, 2008</td>
<td>0.51</td>
<td>0.17</td>
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<td>0.72</td>
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<td>12. Barsuk et al, 2009</td>
<td>0.79</td>
<td>0.70</td>
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<tr>
<td>13. Barsuk et al, 2009</td>
<td>0.77</td>
<td>0.71</td>
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<tr>
<td>14. Stefanidis et al, 2006</td>
<td>0.71</td>
<td>0.55</td>
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<tr>
<td><strong>Overall Effect Size</strong></td>
<td>0.71</td>
<td>0.65</td>
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</table>

- **Favors Traditional Clinical Education**
- **Favors SBME with DP**
Outcome-base assessment and compensation

• Tomorrow’s Doctors 2009, Para 117

• “Medical schools must have appropriate methods for setting standards in assessments to decide whether students have achieved the ‘outcomes for graduates’.

There must be no compensatory mechanism which would allow students to graduate without having demonstrated competence in all the outcomes.”

• Most ‘integrated’ assessment systems have some degree of compensation as an integral feature of their design. Ensuring that each of the outcomes has been passed by every student will require investment in resources and time to alter systems of assessment, data gathering and remediation.
Paragraph 112, Tomorrow's Doctors 2009:

'Medical schools must ensure that all graduates have achieved all the outcomes set out in Tomorrow's Doctors, that is:

- each of the five outcomes under ‘The doctor as a scholar and a scientist’
- each of the seven outcomes under ‘The doctor as a practitioner’
- each of the four outcomes under ‘The doctor as a professional’
- every practical procedure listed in Appendix 1.

This must involve summative assessments during the course that cumulatively demonstrate achievement of each outcome. The medical school must have schemes of assessment that map the outcomes to each assessment event and type, across an appropriate range of disciplines and specialities (‘blueprinting’). Students' knowledge, skills and professional behaviour must be assessed. There must be a description of how individual assessments and examinations contribute to the overall assessment of curricular outcomes, which must be communicated to staff and students.'

Paragraph 117 Tomorrow's Doctors 2009:

'Medical schools must have appropriate methods for setting standards in assessments to decide whether students have achieved the 'outcomes for graduates'. There must be no compensatory mechanism which would allow students to graduate without having demonstrated competence in all the outcomes.'
What are the Barriers?

• Inertia: clinical culture, competence is ascribed socially
• Rigorous, reliable measurement
• Evaluation apprehension
• Teamwork
• Implementation science
• *Not money*
• Measurement of very complex medical problems and outcomes
References


Flynn T (Drafting Panel Chair). *Core Entrustable Professional Activities for Entering Residency (CEPAER).* Washington, DC: Association of American Medical Colleges, 2013.


Mangione S, Nieman LZ. Cardiac auscultatory skills of internal medicine and family practice trainees: a comparison of diagnostic proficiency. *JAMA* 1997; 278: 717-22.


