Physicians Know Why: Reinforcing the Basic Science Curriculum Across Medical Education

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Outline:

1. Why are foundational sciences important?
2. General strategies for reinforcing basic science learning
3. Examples of reinforcement strategies
Definitions

- Foundational (Basic) Sciences: Sciences providing the underpinning of medical practice
  - Physical: Chemistry, Physics
  - Biological: Anatomy, Physiology, Histology, etc.
  - Social: Sociology, Economics
  - [Research competencies]

- Preclinical Curriculum: the earlier phase of medical education, largely spent in classrooms

- Clinical Curriculum: the later phase of medical education, largely spent in clinical settings
Challenges to Basic Science Education

- Time competition in curriculum
  - Residency preparation
  - New curriculum in humanities, systems based practice, economics, etc.
- Student perception of irrelevance, pressure to increase clinical training
- Hyperspecialization of MD and PhD faculty
  - Observed MD rounds show decreasing use of scientific reasoning and examples

(De Bruin, Acad Med 2005)
Why are Foundational Sciences Important?

1. Philosophy: Obligations of a professional

2. Pedagogy: Normal structure and function are the basis for understanding pathophysiology

3. Research
   - Nephrologists use basic science in complex cases (Norman GR, Teach Learn Med 1994)
   - Physiology knowledge correlated with resident (but not faculty) echocardiogram interpretation (Neilson, Adv. Health Sci Ed. (2011))
Strategies for Enhancing Basic Science Education

- **Curriculum**: get rid of the basic science “ghetto”
  - Earlier clinical education
  - Later integrated basic science education
- **Assessment**: test sciences at multiple phases of curriculum
- **Integrated teaching resources**
- **Faculty development**
Curriculum: Flexner Report, 1908

• Pre-1900: US medical education largely apprenticeship-based, with minimal science education

• Post Flexner: Admission to a US medical school should require, at minimum, a high school diploma and at least two years of university study, primarily devoted to basic science.

• The length of medical education be four years, 2 years of basic science and 2 years clinical science
Evolving Curricular Models

Basic Sciences

Clinical Sciences

Year 1 → → → Year 4

Basic Sciences

Clinical Sciences

Year 1 → → → Year 4

See Milbank Report
Evolving Clinical-Science Integration

- **Preclinical Phase**—model integration in class
  - Now an accreditation requirement in USA
  - Problem-based learning
  - Case based learning
  - Team based learning
  - Early clinical immersions (Hofstra)

- **Clinical Phase**: “Return” to foundational science
  - Intersession cases *between* clerkships (e.g. Stanford, UCSF)
  - Integrated small group curriculum *parallel to* clerkship (Case Western)
  - Selective integration courses relevant to senior students’ interests (e.g. Pittsburgh, South Florida, Vanderbilt)
Science and Medicine INTEGRATION

What: Student-centered, case-based, faculty-facilitated small groups

When: Friday afternoons during clinical clerkship rotations

Why: Opportunities to practice:

- Reflection
- Clinical Reasoning
- Clinical Skills
- Application of science to clinical medicine
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Description</th>
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<tbody>
<tr>
<td>1:00 – 1:30</td>
<td>Reflection</td>
<td>Facilitated response to reflection triggers and weekly debriefing of clinical experiences</td>
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<tr>
<td>1:30 – 3:30</td>
<td>Small Group Case Review</td>
<td>Facilitated clinical reasoning and integration of foundational sciences</td>
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<tr>
<td>3:30 – 5:00</td>
<td>Clinical Skills</td>
<td>practice &amp; feedback</td>
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Sample Case: Congenital Heart Disease

• Check-in: Debrief, directed student reflections on dealing with sick children or their parents.

• Go through the case step by step – starting with a “blue baby” – generate a differential diagnosis, discuss the perinatal changes in the circulation.

• Come up with a list of learning objectives and questions for the experts.

• Expert session - paired basic scientist & neonatologist meet with larger group. Mini-didactics + Q&A – focusing on emerging science on the heritable nature of this problem + clinical insights.
Assessment: Student-led Cases

- 3-4 students prepare INTEGRATION afternoon session for their peers
  - Reflection trigger
  - Clinical reasoning skills
  - Basic science element
  - Clinical skill practice

- Faculty observe and assess student presenters according to detailed rubric
1. 12 months Pre-clerkship Phase
2. 12 months Clinical Clerkships
3. Summative Assessment: USMLE study (Parts I and II)
4. 20 month Phase of:
   - Advanced Clinical Experiences
   - Research
   - Integrated Science Courses
   - Electives

For further questions, email Bill.Cutrer@Vanderbilt.Edu
Vanderbilt Integrated Science Courses

• Intense **post-clerkship** courses that:
  – Meet for 40-60 hrs/week
  – Pair teaching of foundational sciences together with clinical experiences
  – Time split roughly 50-50 between the clinical and the classroom environments
  – Mixed educational strategies
  – Competency-based assessment

• VUSM students are required to take 4 ISCs during the 2-year post-clerkship phase
Course Objectives

- To deepen foundational science knowledge during meaningful clinical engagement
- To solidify clinical skills
- To enhance practice-based learning skills
- To ensure readiness for intern role/residency
- To expand knowledge and skills regarding scholarship
- To further grow knowledge and skills regarding leadership
- To encourage professional development
Integrated Science Course Menu

1) Precision Cancer Medicine
2) Cardiovascular Diseases
3) Critical Illness
4) Community Healthcare
5) Diabetes Mellitus
6) Global Health
7) Getting Hooked: Addiction
8) Immunity and Infections in the Immune-Compromised Host
9) The Skinny on Obesity
10) Injury, Repair, and Rehabilitation
11) Medical Imaging and Anatomy
12) Infectious Diseases
13) Sexual Medicine and Reproductive Health

https://medschool.vanderbilt.edu/ume/integrated-science-courses
For further questions, email Bill.Cutrer@Vanderbilt.Edu
Cardiovascular Disease
Lisa Mendes, MD, Julie Damp, MD, Steven Eskind, MD, Steven Ball, MD, Robert Deegan, MD

Science
Cardiovascular anatomy and physiology, Etiology and pathophysiology of atherosclerosis, Hemodynamics of cardiovascular system in health and disease, Pharmacology, Pathophysiology, diagnosis and treatment of acute coronary syndromes, acute myocardial infarction, congestive heart failure, aortic stenosis, atrial fibrillation and wide complex tachycardia, Pathophysiology, diagnosis and treatment of common forms of carotid and peripheral vascular disease, and aortic disease

Clinical Settings
Four, one week clinical experiences in the following areas: CT surgery, Vascular Surgery, CT Anesthesia, General Cardiology/Interventional, General Cardiology/Imaging, Electrophysiology, Heart Failure

Specialty Interests
Internal Medicine, Cardiology, Critical Care, Vascular Surgery, Cardiothoracic Surgery, Anesthesia, Emergency Medicine
Assessment

- Knowledge-based module quizzes and final exam
- Written clinical reflections
- Competency-based milestones (Clinical & Classroom setting)
  - Self-Assessment
  - Peer Assessment
  - Faculty Assessment

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• Integrated teaching resources

• Faculty development
Evolving Timing of Summative Assessment

See Milbank Report
A New Strategy for Summative Assessment: USMLE Step 1 after Clinical Clerkships

• 10% of US schools now trying this
• Motivations:
  – Shorten preclinical phase (which includes study time for USMLE Step 1), extend time for later research
  – Reinforce basic science learning by having student review it after they have clinical context
• Can students delay this test and still succeed?
  – Step 1 important for residency placement in USA: role of student anxiety
  – Anecdotally, test performance is unchanged at one school
  – How will weaker test takers do?
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New Courses for a New Decade
What is MedU Science?

A new course from the International Association of Medical Science Educators (IAMSE) and MedU that integrates the basic science and clinical medicine.
Why MedU Science?

Cognitive integration of basic science and clinical medicine toward the endpoint of entrustment to make optimal clinical decisions
MedU Science – Who are the Learners?

• Clerkship and post-clerkship medical students
• Health professions students who will be making clinical decisions
• Basic science and clinical educators – Faculty Development
MedU Science – Topics

• Traditional Basic Sciences
• Common Clerkship Disciplines
• Common Clinical Conditions
  • Five Decisions
    • Diagnosis
    • Work-up
    • Management
    • Course of Illness
    • Prevention
MedU Science – Topics Covered

BASIC SCIENCE EDUCATORS
Multi-institutional teams of IAMSE members developed core concepts for each of 12 major basic science disciplines.

1. Anatomy
2. Biochemistry
3. Cell Biology and Signaling
4. Embryology
5. Genetics
6. Immunology
7. Microbiology
8. Molecular Biology
9. Neuroscience
10. Pathology
11. Pharmacology
12. Physiology
   - Cardiovascular
   - Connective tissue
   - Endocrine
   - Gastrointestinal
   - Hematopoietic/bone marrow
   - Musculoskeletal
   - Nervous system
   - Renal/urinary
   - Reproductive
   - Respiratory

CORE CLINICAL CONDITIONS

1. 160+ concepts were linked to
2. 100+ core conditions

CLINICAL EDUCATORS
A multi-institutional team representing 9 major clinical disciplines developed a list of common CORE CLINICAL CONDITIONS utilizing each discipline’s national core curriculum.

- Family Medicine
- Intensive Care
- Emergency Medicine
- Internal Medicine
- Obstetrics/Gynecology
- Neurology
- Pediatrics
- Psychiatry
- Surgery
MedU Science – Teaching Tools

The Curriculum

• Basic science concepts, teaching points, recall tools
• Learning objectives through common conditions
• Prevention of harm

Virtual Patient Cases

• Short cases (15 minutes)
• ‘Parachute’ into scenario
• “Augmented” clinical reasoning (causal + clinical)
• Towards clinical decision-making entrustment

Active learning integration sessions
MedU Work To Date

• Basic Science core concepts
• Core Clinical Conditions / “curricular epidemiology”
• Integrated learning objective template
• Example vignette
MedU Science Timeline

- **June 2017**: Beta cases first available to IAMSE membership at the June IAMSE meeting
- **March 2018**: Pilot testing and peer review completed
- **June 2018**: Initial series of MedU Science cases available by subscription
- **June 2019**: Active learning integration tools available
Learn More

- http://www.med-u.org/medu-science
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Increasing Integrated Teaching Ability

- PhDs teach with MDs in preclinical TBL, PBL, etc.
- PhDs teach and/or lead senior integration courses
- Teaching fellowships for MD graduates that includes basic science review
- Students bring basic science to ward rounds
- FD conferences: AMEE, International Assn. of Medical Science Educators (IAMSE)
Summary/Commentary

• Basic science education is fundamental to the medical professional as the basis of practice and part of clinical decision making.

• It should be included across the continuum, not ghettoized in early years.

• It should be tested across the continuum.

• Expand curricular and assessment experiments with goal of fostering integration.

• Integrated teaching resources and faculty development should be expanded.
Comments and Questions?