Basic Sciences in Medical Education: From Flexner to Today
(IAMSE Report on Basic Sciences in Medical Education)

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Themes of Flexner Report

• Overproduction of uneducated and ill-trained physicians
• Commercial, for-profit medical schools
• Educational methods: primarily didactic with inadequate laboratories and experiential activities
• Poor student preparation; lack of rigorous and uniform admission standards
• Need for educationally sound teaching hospitals affiliated and supported by Universities
Outcomes of Flexner Report
- Academic Model of Medical Education -

- Reduction in medical schools
- Reduction in physician graduates
  - better education and training
- Medical school affiliation with a college/university
  - financial support and academic rigor
- Uniform admission standards and general curricular design
- Higher quality faculty
- Fundamental role of the sciences
Basic Sciences in Medical Education Today

- Uniform and rigorous admissions standards
- 2+2 Curricular structure
- Didactic-based instructional methods
- Minimal laboratory instruction and activities
- Highly structured time
- Tension to increase instruction on clinical application, behavioral, ethical and management knowledge and skills while maintaining a focus on the sciences fundamental to medicine and the core skills necessary for preparation for the clinical experiences
Flexner Revisited Study Project

• IAMSE-initiated project in 2006
• Study Group:
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  – Louis Pangaro
  – Peter Anderson
  – Aviad Haramati
  – Nehad El Sawi
  – Gary Rosenfeld
  – Tom Schmidt
  – Doug Wood
  – George Dunway
  – Many other contributors

• IAMSE
• Alliance for Clinical Education
• Generalists in Medical Education
• Society of Osteopathic Medical Educators
• Group for Educational Affairs (AAMC)
• American Physiological Society
• American Society for Pharmacology and Experimental Therapeutics
• Group for Research in Pathology Education
• Other discipline societies
Flexner Revisited: Defining the Role and Value of the Basic Sciences in Medical Education

Goals:

1. Define and describe the sciences that constitute the foundation of medicine
2. Identify the role and value of the sciences and scientific thinking in medical education
3. Identify the best practices of when, where and how the foundation sciences should be incorporated into medical education
Flexner Revisited: Questions to be Addressed

1. What are the sciences that constitute the foundation for medical practice?

2. What is the value and role of the foundational sciences in medical education?

3. When and how should these foundational sciences be incorporated into the medical education curriculum?

4. What sciences could/should be pre-requisite components of the undergraduate medical curriculum (i.e. be part of the pre-medical requirements)?

5. What are examples of the best practices for incorporation of the foundational sciences in the medical education curriculum?
WHAT ARE THE SCIENCES THAT CONSTITUTE THE FOUNDATION FOR MEDICAL PRACTICE OF THE FUTURE?

• Traditional ‘Basic Sciences’
  – Anatomy
  – Physiology
  – Biochemistry
  – Microbiology/Immunology
  – Pathology
  – Pharmacology
• Genetics
• Molecular biology
• Epidemiology (Biostatistics)
• Behavioral sciences
WHAT ARE THE SCIENCES THAT CONSTITUTE THE FOUNDATION FOR MEDICAL PRACTICE OF THE FUTURE?

- Clinically relevant and applicable to medical practice
- Goal is understanding of the fundamental principles to develop effective thinking, reasoning and problem-solving skills
“A man cannot become a competent surgeon without a full knowledge of human anatomy and physiology, and the physician without physiology and biochemistry flounders along in aimless fashion, never able to gain any accurate conception of disease, practicing a sort of popgun pharmacy, hitting now the malady and again the patient, he himself not knowing which.”

Sir William Osler (1849-1919)
WHAT IS THE VALUE AND ROLE OF THE FOUNDATIONAL SCIENCES IN MEDICAL EDUCATION?

- Critical for clinical application and effective thinking skills
- Promotes observational skills and attention to detail
- Develops respect for human body and person - anatomy
- Integrative approach to problem-solving
- Normal structure and function
  - basis for understanding abnormal-(pathophysiology)
- Grounds clinical practice
- Basis for understanding
  - Common $\rightarrow$ algorithm
  - Complex or unusual $\rightarrow$ deeper learning and understanding
  - Mimicry $\neq$ competency and quality
WHAT IS THE VALUE AND ROLE OF THE FOUNDATIONAL SCIENCES IN MEDICAL EDUCATION?

The question raised is fundamental; the answer decides the sort of medical education that we shall seek generally to provide. If, in a word, scientific method and interest are of slight or no importance to the ordinary practitioner of medicine, we shall permanently establish two types of school,—the scientific type, in which enlightened and progressive men may be trained; the routine type, in which “family doctors” may be ground out wholesale.

Flexner Report
Basic Science Provided Relevant Preparation for Clerkships

Source: 2003-2007 AAMC Medical School Graduation Questionnaire
WHEN AND HOW SHOULD THESE FOUNDATIONAL SCIENCES BE INCORPORATED INTO THE MEDICAL EDUCATION CURRICULUM?

• Early and throughout all 4 years
• Incremental
  – Repetition/redundancy
• Avoid Curriculum attack ("hard and fast")
  – Dispersal over longer time
  – Opportunity for distillation vs efficiency
• Process vs content
• Experiential vs didactic

2 That method rather than any particular content is the very essence of scientific discipline is admirably pointed out by Professor Dewey in his address "Science as Subject-matter and as Method," *Science*, xxxi., no. 787, p. 122. “Science has been taught too much as an accumulation of ready-made material, with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.”

*Note: Flexner Report*
Knowledge Retention Over Time

![Graph showing test re-test percentage scores for Neuroanatomy, Immunology, and Physiology.](Source: BMC Med Educ. 6:5, 2006)
WHAT ARE EXAMPLES OF THE BEST PRACTICES FOR INCORPORATION OF THE FOUNDATIONAL SCIENCES IN THE MEDICAL EDUCATION CURRICULUM?

See Milbank Report
WHAT SCIENCES SHOULD BE PRE-REQUISITE COMPONENTS OF THE UNDERGRADUATE PREMEDICAL CURRICULUM?

• Retain the diversity of matriculants
• Biology
  • mammalian biology; not just any kind of biology
• Genetics, molecular/cell biology; biochemistry; anatomy and physiology
• Basic science vocabulary and core concepts
  – students start UGME from a common level of understanding
• Statistics – as a means to develop thinking skills
• Courses promoting problem solving and reasoning skills
• Ethics
• Increased pre-requisites means that UGME could start at a higher level of basic sciences content
  – Impact on diversity of medical school classes and the contribution of non-science preparation (e.g., humanities)
  – Concerns that some prerequisite courses are not taught from the perspective of medicine
WHAT SCIENCES SHOULD BE PRE-REQUISITE COMPONENTS OF THE UNDERGRADUATE PREMEDICAL CURRICULUM?

• Cognitive skills and
Pre-Medical Preparation

Scientific Foundations for Future Physicians

Report of the AAMC-HHMI Committee

2009
### Competency M1
Apply knowledge of molecular, biochemical, cellular, and systems-level mechanisms that maintain homeostasis, and of the dysregulation of these mechanisms, to the prevention, diagnosis, and management of disease.

### Competency M2
Apply major principles of physics and chemistry to explain normal biology, the pathobiology of significant diseases, and the mechanism of action of major technologies used in the prevention, diagnosis, and treatment of disease.

### Competency M3
Use the principles of genetic transmission, molecular biology of the human genome, and population genetics to infer and calculate risk of disease, to institute an action plan to mitigate this risk, to obtain and interpret family history and ancestry data, to order genetic tests, to guide therapeutic decision making, and to assess patient risk.

### Competency M4
Apply the principles of the cellular and molecular basis of immune and nonimmune host defense mechanisms in health and disease to determine the etiology of disease, identify preventive measures, and predict response to therapies.

### Competency M5
Apply the mechanisms of general and disease-specific pathological processes in health and disease to the prevention, diagnosis, management, and prognosis of critical human disorders.

### Competency M6
Apply principles of the biology of microorganisms in normal physiology and disease to explain the etiology of disease, identify preventive measures, and predict response to therapies.

### Competency M7
Apply the principles of pharmacology to evaluate options for safe, rational, and optimally beneficial drug therapy.

### Competency M8
Apply quantitative knowledge and reasoning—including integration of data, modeling, computation, and analysis—and informatics tools to diagnostic and therapeutic clinical decision making.
WHAT ARE EXAMPLES OF THE BEST PRACTICES FOR INCORPORATION OF THE FOUNDATIONAL SCIENCES IN THE MEDICAL EDUCATION CURRICULUM?

• Clinical presentation as focus
  – Problem set with vignettes
• Incorporate biosciences in clinical years
• Incorporate clinician perspective into the basic science teaching
• Build on principles of adult learning towards knowledge application
• More time for thinking and reflecting; application and connections
Summary

• Traditional mammalian sciences fundamental to medical practice
  – Understanding the sciences key aspect distinguishing physicians as clinical scientists vs technicians

• UME curriculum:
  – Clinical relevance
  – Promote deep learning
  – Integrated with clinical experience

• understanding foundational sciences are essential to developing discipline and rigor for clinical reasoning and problem-solving
Resources

• Medical Teacher  
  – 31(9) September 2009
• Academic Medicine  
  – 85(2) February 2010

• JIAMSE  
  – Summer 2010