Chapter

# Contemporary Medical Education: Revolution versus Evolution

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## Abstract

Contemporary and traditional approaches to undergraduate medical education (UME) and graduate medical education (GME) are compared and differences are highlighted. A case is made that the contemporary medical education system is being subject to the downside of disruptive innovation with unintended and potentially detrimental long-term outcomes for academic medicine and clinical practice. The impact on various constituencies is discussed. Proposed solutions are presented. The challenges for education of the best possible physicians are daunting but must be met to honor the social contract between medicine and society.

**Keywords:** medical education, basic science, pathology, integrated curriculum, traditional curriculum

## 1. Introduction

The standard medical educational system during most of the twentieth century was developed in response to the 1910 Flexner report and has served as a successful template for the development of generations of physicians [1]. Yet the new millennium has ushered in major changes that have constituted a revolution in undergraduate medical education (UME) and graduate medical education (GME) [2–4]. Measured change has been supplanted by disruptive innovation with the risk of unintended consequences and potentially detrimental long-term outcomes for academic medicine and clinical practice [1, 5]. This critique is based on the author's experiences over a long career as a physician-scientist engaged in medical education, translational research and clinical practice of autopsy and cardiovascular pathology, and as an academician who also has held several academic leadership positions.

## 2. The past century in medical education

Traditional medical education has been shaped by guiding principles formulated by Abraham Flexner and William Osler early in the twentieth century. In his seminal 1910 report, Flexner stated that medical schools should be university based, have minimum admission requirements, implement a rigorous curriculum with applied laboratory and clinical science content, and have faculty actively engaged in research. Osler developed a system of bedside teaching which emphasized medical students learning clinical medicine from direct encounters with patients under the guidance of faculty clinicians. The insights of Flexner and

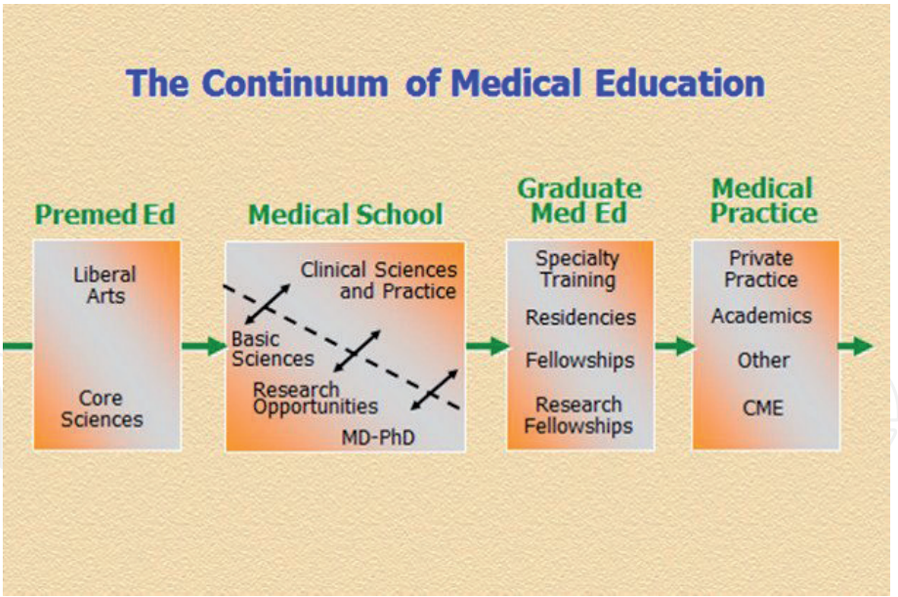


**Figure 1.**
*Diagram presenting the continuum of medical education including a traditional approach to undergraduate medical education modified to provide progressive integration of basic biomedical sciences and clinical disciplines.*

Osler resulted in the establishment of a model of medical education with two key components or pillars, namely, the basic or foundational sciences and the clinical sciences [1]. The two-pillar model of medical education served as the basis for a four-year UME curriculum comprising biomedical science courses in the pre-clinical years and clinical clerkships in the clinical years. Over the years, thoughtful analysis has brought about modifications to promote integration of the two components (**Figure 1**). Medical schools utilizing this construct produced scientifically grounded and clinically skilled physicians as well as a subset who pursued successful careers as physician-scientists and academicians.

## 3. The new curriculum and competency-based education

Yet, in response to criticisms of the traditional system and changes in the health-care landscape, sweeping changes have been launched in UME and GME with the goal of producing physicians "fit for the twenty-first century" who are adept in functioning in ever changing health care delivery systems [2–4]. The post-Flexnerian UME is based on the so-called fully integrated spiral curriculum encompassing both horizontal and vertical integration across time and across disciplines (**Figure 2**) [6].

The fully integrated UME curriculum resulting from the redesign eliminates a distinct focus on the critically important pre-clinical, basic medical sciences as a foundation for the clinical clerkships. Health Systems Science encompassing diverse topics including population health and interdisciplinary care now is included as a co-equal to basic and clinical sciences. The emphasis is on developing skills in modern clinical reasoning and decision-making and on the demonstration of "competencies" rather than cognitive knowledge. The result of these initiatives has been a loss of a significant amount of time and emphasis on the basic biomedical sciences in the curriculum. The new post-Flexnerian paradigm fits the definition of disruptive innovation. Innovation is a driver of progress, but disruptive innovation is prone to risks and unintended consequences [5].

In the United States, standards for UME and GME are set by the Liaison Committee for Medical Education (LCME), and its sponsoring institutions, the

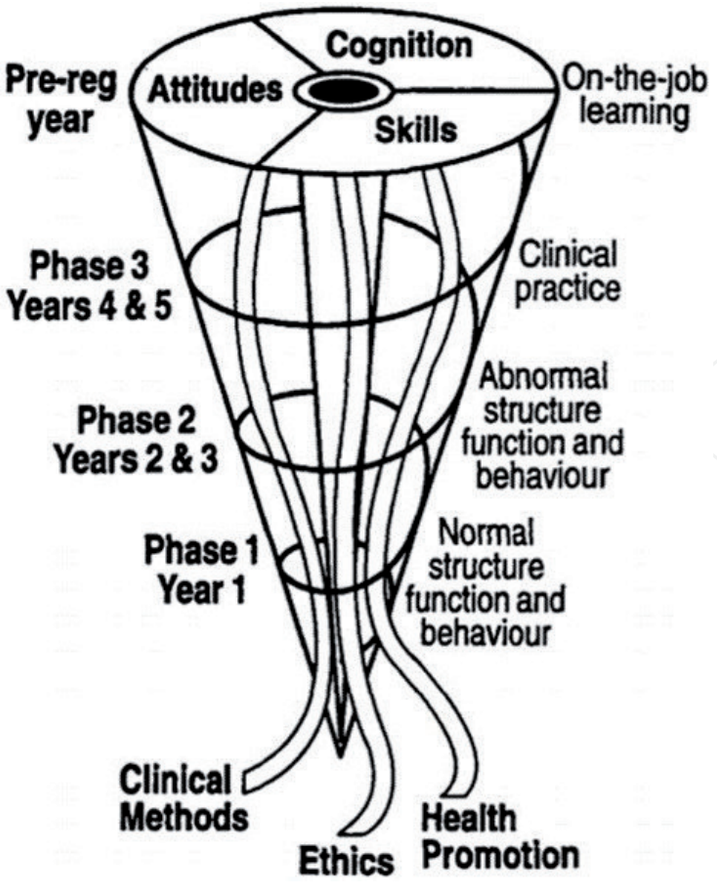


**Figure 2.**
*Diagram presenting the concept of a fully or spirally integrated curriculum including simultaneous vertical and horizontal integration. The complexities in realizing this model are considerable, as reflected in the diagram.*

American Association of Medical Colleges (AAMC) and the American Medical Association (AMA), and the Accreditation Council for Graduate Medical Education (ACGME). Regulatory bodies in other countries have had similar roles. Curriculum reformers have used actual and perceived expectations of the LCME and ACGME to drive curriculum revision.

The movement toward outcomes and competency-based education in UME follows innovations in GME, which the Accreditation Council for Graduate Medical Education (ACGME) to implement the six competencies as key elements in residency training programs [3, 4]. These competencies relate to patient care, medical knowledge, interpersonal and communication skills, professionalism and practice-based learning and improvement. The ACGME has moved further along the path of competency-based training with the introduction of milestones as a focus of the new accreditation system (NAS). Competencies also have been linked to Entrustable Professional Activities (EPA). Other concepts under discussion include an accelerated three-year UME program and/or time variable criteria for the granting of the medical degree as well as certification in medical specialties following a period of graduate training.

## 4. Critique

### 4.1 Paradoxes

The fully integrated, competency focused curriculum for UME and GME is promoted as the optimal approach to produce physicians with skills in modern

clinical reasoning and diagnostic and therapeutic decision making. Yet, the solid grounding in the basic biomedical sciences required for high level clinical reasoning and decision making has been diminished. Also, deterioration in history taking and physical examination skills of medical trainees has occurred over the last twenty years contemporaneously with the implementation of the new curriculum [7].

### 4.2 Unintended consequences and downsides

The paradigm shift in medical education is based on the premise that changes in the healthcare system and in medical practice in the clinic and hospital have outpaced those in the classroom, resulting in a declining relevance of the traditional curriculum [2]. The claim is that reduction and revamping of the basic science content is readily achieved by elimination of perceived redundancy in the old curriculum. But the reality is that biomedical science, both in terms of curriculum time and emphasis, has been diminished in the new curriculum. Further negative pressure on the basic sciences is coming from the initiative to incorporate Health Systems Science into the curriculum with the associated need to develop faculty with skills in teaching this material. Furthermore, transitioning from a few basic scientists lecturing entire classes from the podium to numerous small groups often tutored by clinical faculty dramatically increases the teaching demands on all faculty and especially faculty clinicians.

Implementation of the new curriculum has required trade-offs, with certain topics such as clinical decision-making, comparative effectiveness and other Health Systems Science topics given priority over the depth of basic science content presented in traditional courses. The justification given for this major revamping and truncation of basic science in the curriculum is perceived excessive and unnecessary detail of course content as well as major overlap and repetition among traditional basic science courses. While strong emphasis is placed on integrating basic science courses and providing clinical experiences early in the curriculum, the extension of basic science content into the clinical years has been a major challenge and a major shortcoming of the integrated curriculum [1].

### 4.3 Impact on medical educators

The reconstruction of the content of the UME curriculum as well as pedagogical methods geared to the learning styles of contemporary students requires a major increase in commitment of faculty and staff for the delivery of content in smaller groups than in a lecture format [8]. The lecturer now is being reprogrammed as a learning facilitator, creating stress for many faculty members [9].

Medical educators, including basic biomedical science educators and clinician educators, are faced with adapting to major changes in the curriculum. Many medical educators have experienced significant challenges in the implementation of the new curriculum. A curriculum heavily geared to small group teaching places considerable additional demand on faculty who have to meet multiple competing demands. A significant inverse relationship has been found between faculty members' readiness to change teaching approaches and their severity of burnout [10].

While attempting to cope with major revision of the curriculum, faculty also have special challenges in educating the current generation of medical students [8]. Certainly, faculty educators need to be cognizant of the characteristics of today's students and how they approach leading in the Information Age. However, faculty educators still need to set expectations regarding standards of performance. Pedagogical approaches can be modified to meet the learning pattern of today's medical students, for example, by blending lecture and non-lecture formats.

Nevertheless, faculty educators must continue to set standards for content and learning without compromise on the material that must be learned.

### 4.4 Impact on pathology

As both a medical science and a clinical discipline, pathology is seminally important in linking the basic biomedical sciences to clinical medicine and providing an understanding of the pathobiological basis of disease [1]. Since a solid understanding of pathology is core to the practice of medicine in any specialty, all medical students must learn the basic mechanisms of disease, their manifestations in major organ systems, and how to apply that knowledge to clinical practice for diagnosis and management of patients. However, the place given to the pathobiological basis of disease and pathophysiology of mechanisms of disease in the new curriculum models is undervalued.

Although a traditional curriculum includes a formal pathology course, students generally have little exposure to pathology or pathologists in the professionally formative clerkship years. In the new curriculum, the goal of grounding medical students in principles of pathology, including pathogenesis and pathophysiology of disease, has been made considerably more difficult. The resultant discontinuance of pathology courses and their replacement by elements of pathology scattered episodically in the pre-clinical years likely has resulted in the dilution of core scientific principles and a decreased appreciation of pathophysiology.

The assessment of pathology educators is that the new LCME-driven curriculum is producing a medical graduate who is being taught to think differently, but is deficient in subject-specific knowledge for a variety of medical specialties [11]. Pathology educators are striving to adapt pathology teaching to changes brought about by the new curriculum and compounded by the disruption caused by the COVID-19 pandemic [12]. While these approaches cannot fully substitute for the coherent presentation of the pathobiological basis of disease in a pathology course, it is imperative that pathology educators make this effort.

## 5. Solutions

### 5.1 Restore a focus on the scientific basis of medical practice

The first two years of the UME curriculum is the time when the fundamentals of biomedical science and the clinical skills of taking a history and physical examination are to be formally taught and learned. A combination of factual knowledge and relationships among facts is crucial for developing clinical skills, critical thinking and evidence-based medical decision-making. Clinical skill and judgment are gained from the integration of conceptual knowledge (facts, "what" information), strategic knowledge ("how" information) and conditional knowledge ("why" information) [13]. The learning experience of the core material in the pre-clinical years should not be diluted by substituting other topics that are best learned after a foundation is laid for clinical practice.

There are more effective ways to achieve the objective of integration in the curriculum without sacrificing the foundations of a good medical education. An overarching priority is the repositioning of medical science in the medical education curriculum to reflect its unchanging and continued importance. While restoration of subject-based foundational courses is unlikely to happen, the integrity and cohesion of the foundational disciplines should be maintained. This is especially true for pathology which fulfills the essential functions of linking basic biomedical

science to clinical medicine and providing an understanding of the pathological basis of disease. Studies have repeatedly shown that factual knowledge of biomedical science is essential for the development of clinical skills [1]. The deemphasis on biomedical science also cannot be good for the development of future physician-scientists, a small and already endangered group [1].

There is general agreement that medical education should be focused on developing competent physicians. However, application of competency-based curriculum adapted from lower-level occupations to highly skilled professions including medicine is controversial [14]. The logistics of implementing such programs are daunting and represent another major draw on faculty time to provide evaluation of the set of competencies and entrustable professional activities (EPAs) expected of the learners. A more feasible approach would be to maintain fixed time programs but allow accelerated advancement coupled with opportunities for dual degrees, pursuit of research, and other projects.

It is also important to counter the undue influence of the United States Medical Licensing Exam (USMLE) Step 1, as the sole objective evaluator of medical students' cognitive achievement. This has created an adverse "Step 1 climate" in the preclinical years [15]. The recent decision of the National Board of Medical Examiners to make the USMLE a pass/fail exam without reported numerical score is well intended. However, the most residency program directors have raised concerns and are seeking alternatives for objective assessment of residency candidates [16]. A definitive solution requires a return to providing meaningful grades for courses and an overall rigorous summative evaluation for the four years of medical school.

### 5.2 Promote a culture of professionalism

A major goal of the new curriculum is the development of holistic, ethical physicians who manifest empathy and compassion for patients. These ideals of the medical profession are time-honored and intrinsic to its code of ethics. A long-standing consensus holds that professionalism and professional identity formation need to be key elements of medical education. However, there is not a unifying theoretical or practical model to integrate the teaching of professionalism into the medical curriculum. Nevertheless, there is recognition that the most effective techniques for developing professionalism involve role modeling and personal reflections guided by faculty rather than blocks of time devoted to didactic exercises. A practical approach to dealing with differing expectations and to effectively instill professionalism is to provide students, residents and staff with a written list of expected behaviors coupled with teaching and role modeling, assessment and remediation [17].

Clinician educators have crucially important roles in developing clinical skills in trainees as well as serving as role models of professionalism and excellence in medical practice [18]. Medical schools need to address barriers to the professional development of clinician educators and provide appropriate incentives to foster their ongoing educational activities. Similar recognition should be given to a cadre of basic science educators. The Academy movement has developed to meet the need to recognize and support medical educators [19].

### 5.3 Focus on the physician as medical expert

There is a broad consensus that the good doctor manifests a combination of humanistic and scientific attributes and capabilities. Seven key roles of the ideal doctor have been identified as communicator, collaborator, manager, health advocate, scholar, professional, and the integrating role of medical expert [20].

Importantly all the roles overlap equally to create the 'Medical Expert'. Maturation from novice to master in (medical expert) needs to be built on a solid foundation in biomedical science and the pathobiology of disease. The time and place to inculcate the core of this foundation is the first two years of the UME. A solid foundation in biomedical science is essential for perfecting clinical skills and practicing evidence-based medicine. A byproduct of a restoration of a strong medical science curriculum will be a boost to the development of future generations of physician-scientists. Conversely, the combination of educational deficiencies coupled with lifestyle preferences carries the risk of diminishing the status of future physicians.

## 6. Conclusion

Whereas there is merit in the goal of the new curricula to produce holistic physicians, educational revisions must avoid producing graduates who do not have the level of expected clinical expertise because they do not have a sufficient grounding in biomedical science or a deep understanding of the pathological basis of disease. Enthusiasm for reform needs to be tempered by a more cautious and realistic approach to avoid unintended consequences.

Unless there is further modification, the new curriculum is at risk of producing graduates who are lacking in the characteristics which have set physicians apart from other healthcare professionals, namely superior clinical expertise based on a deep grounding in biomedical science and understanding of the pathobiology of disease. Physicians need to remain the preeminent medical experts who have understanding of basic pathophysiological mechanisms, particularly in dealing with difficult cases. The challenges for education of the best possible physicians are great but the benefits for medicine and society are enormous.

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