

## Feature

# From the National Academies: Medical School Admissions Requirements and Undergraduate Science Education

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This article focuses on a series of related issues that appear to be of (sometimes passionate) interest to college and university science faculty who educate undergraduates: requirements and policies for admission to medical school and their possible influences on undergraduate science education. The Center for Education of the National Research Council (NRC) and the Institute of Medicine (IOM)<sup>1</sup> are considering undertaking one or more activities that would help elucidate the relationship and interdependence of undergraduate and medical education.

In the Winter 2004 issue of *Cell Biology Education*, we asked readers to provide their perspectives and input on issues related to introductory science courses; here, in similar fashion, we seek your input about issues you have encountered when teaching courses that are part of the premedical curriculum. To begin a discussion thread or to respond to comments that other readers have submitted, simply click on the “article discussion forum” box in the top left corner of the screen, or go to <http://cellbioed.org/discussion/public/main.cfm>.

## BACKGROUND

Most professions have established standards for their members and for the preprofessional education programs that serve as entry points. However, in dynamic professions such as medicine, where both the knowledge base and the demographics of students in preprofessional programs are undergoing rapid change, these standards, along with the educational process itself, need to be continually examined.

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<sup>1</sup> The NRC and the IOM constitute two of the four units of the National Academies. The National Academies is a private, non-profit organization with a charter to assist the federal government and the American people in analyzing pressing science and technology policy issues. The other National Academies units are the National Academy of Sciences and the National Academy of Engineering. Much of the work of the National Academies is performed by leading scientists, mathematicians, engineers, social scientists, and policy experts who provide pro bono service to the National Academies and to the nation. Additional information is available at <http://nationalacademies.org>.

A medical school's curriculum and its expectations for student learning are affected, in part, by the prerequisite knowledge required of those who are enrolled. For example, for many decades, medical schools in the United States have required that all applicants for admission complete a full year each of biology, general chemistry, organic chemistry, and physics as undergraduates. To help determine if applicants have the subject knowledge required to be successful, schools use the Medical College Admission Test (MCAT) to assess mastery of content that is deemed important by most medical schools in the United States (Etienne, 2002a) and is taught in most of the required undergraduate science courses (Etienne, 2002b).

However, the science that underlies medicine has changed dramatically since such requirements were established. For example, in 2001 the Association of American Medical Colleges conducted a survey of medical school faculty (Etienne, 2002a); the results suggest that respondents viewed organic chemistry as being less important to current medical study than did the respondents of a similar survey undertaken in 1988.<sup>2</sup> In addition, results of the 2001 survey indicated that undergraduate education in biology was considered a more important prerequisite for admission to medical school when compared with results of the 1988 survey.

According to Etienne (2002a, b), subject areas included on the MCAT are based on knowledge that medical school faculty deem an important prerequisite for medical education and on data that undergraduate science faculty provide regarding particular topics that are included in a premedical curriculum. However, medical schools do not (and cannot) specify the content of those prerequisite courses, and most MCAT examination questions are not made public.<sup>3</sup> Thus, it remains unclear whether individual undergraduate faculty align their courses to what is tested by the MCAT or to what

<sup>2</sup> Johnson and Julian (2001, as reported in Etienne, 2002a) also found that students who had completed at least two years of medical school indicated that the topics that they had learned in their prerequisite undergraduate course in organic chemistry was not critical to their success as medical students.

<sup>3</sup> Representative samples of questions from recent MCAT examinations are available at <http://www.aamc.org/students/mcat/start.htm#sample>.

is expected of students who eventually matriculate in medical schools.

The expectation across all three factors in medical education—undergraduate science courses, the MCAT, and medical school coursework—is that each works to reinforce the others by establishing a number of standards for course and admissions requirements based on the stated prerequisites. But a lack of alignment of expectations between undergraduate science and medical education may hinder changes in pedagogy, curriculum, and assessment that research suggests could improve undergraduate science education. Unless there is clear understanding of academic expectations between the schools that prepare students and those that accept them for the next higher level of education, these curricular requirements and tests may produce unanticipated and possibly unwanted consequences for all three components in medical education.

However, it remains unclear whether, and to what extent, such misalignments actually occur. Both formal reports (e.g., NRC, 2003) and informal perceptions of undergraduate science faculty suggest that these three legs of the medical education system are not in alignment. Etienne (2003b) reported that a survey of undergraduate faculty found that topics that medical school faculty deem important as prerequisites are being covered sufficiently in undergraduate introductory science courses. However, Etienne commented that some undergraduate faculty contend that the reverse does not hold true (i.e., not all topics that undergraduate faculty believe are important are viewed as being so by medical schools). These faculty argue that this disparity "... may inadvertently result in introductory science curricula based solely on the needs of students intending to take the MCAT rather than on the goal of thorough content coverage to meet the needs of the general introductory science student population." (Etienne, 2002b, p. 5). In contrast, other respondents pointed out that "... the MCAT, in addition to being a good predictor of success in medical school, is built from specifications based on undergraduate introductory science curricula." (Etienne, 2002b, p. 5).

Besides reliance on prerequisite introductory-level knowledge of the sciences, new approaches to medical education in the past decade (e.g., case-based approaches to medical education) emphasize other kinds of skills (e.g., oral communication, problem-solving, and teamwork) that are not assessed by the MCAT. And, it is becoming increasingly clear that success in medical school and in the medical profession also may be influenced by other kinds of learning that are not tested by the MCAT. For example, a study committee of the IOM (2003, p. 3) recommended that "All health professionals should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidence-based practice, quality improvement approaches, and informatics."

Developing teamwork skills and helping students learn to use quantitative evidence for decision-making are emphasized also in *Bio2010: Transforming Undergraduate Education for Future Research Biologists* (NRC, 2003). Research suggests that teaching such skills in undergraduate courses could enhance science education and might increase interest in science, technology, engineering, and mathematics for a broader spectrum of that student population. However, undergraduate faculty often report that they feel compelled to emphasize factual knowledge in their courses for

premedical students, rather than to develop these other kinds of skills (NRC, 2003).

Overreliance on standardized tests also can lead to disparities and inequities in the kinds of students that are admitted to medical and other professional schools. For example, another committee of the IOM (2004) summarized data showing that, for reasons generally associated with fewer opportunities for high-quality education, underrepresented minority students typically score lower on a range of standardized tests than do their Caucasian or Asian-American counterparts, and therefore are less successful in gaining admission to medical and other professional schools. That report and others that it cited (e.g., Cohen, 2003) predicted that without admissions practices that allow applicants' race or ethnicity to be considered along with other personal characteristics, participation by underrepresented minority students in the health professions is likely to decline sharply in the future.<sup>4</sup>

## POSSIBLE NEXT STEPS

There is a clear need for a dialogue between the undergraduate science and medical education communities about the connections between the current requirements for admission to medical school, the content and emphasis of the MCAT, and the changing emphases within undergraduate science education. In response, the NRC's Center for Education and the IOM have begun conversations about possible activities that our organizations might undertake in concert with the Association of American Medical Colleges and professional societies in the natural sciences to examine these issues in ways that would benefit all stakeholders.

Accordingly, we seek your input regarding whether this kind of work would be useful to you and your departmental colleagues who are directly involved with the preparation, teaching, and administration of introductory undergraduate science courses and other courses that emphasize premedical education. We would like to know the most important questions you feel need to be addressed and the kinds of data that would help to move these conversations forward.

The editors of *Cell Biology Education* have agreed to assist this effort by establishing a discussion thread on their Web site; it can be accessed directly at <http://cellbioed.org/discussion/public/main.cfm> or through a link from the online version of this article. Initially, the Web site will contain discussion threads about the intersection of undergraduate and medical education. You are encouraged to enter your perspectives on this topic, to respond to comments posted by other readers, or to initiate discussion threads on related topics that are of concern or interest to you. Staff from the Center for Education and the IOM will review input from this Web site and will use the information to decide possible next steps.

<sup>4</sup> In contrast, an October 20, 2004, press release from the Association of American Medical Colleges reported that, following a drop in 2003 in enrollments of African-American and Hispanic students in medical school, the reverse was observed in enrollments in 2004. The press release is available at <http://www.aamc.org/newsroom/pressrel/2004/041020.htm>.

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