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The Coming Revolution in Pre-medical Preparation:

A Multi-Disciplinary Perspective



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Abstract

In June 2014 Icahn School of Medicine at Mount Sinai hosted a national summit on pre-medical preparation that was supported by a grant from the Josiah Macy, Jr. Foundation. Select individuals were invited from every discipline that plays a part in pre-medical preparation: pipeline and post-baccalaureate programs, undergraduate science educators, admissions deans, pre-health advisors, leaders of innovative pathways, and some 'thought leaders' from the AAMC and HHMI. Prior to the Summit, each group put together a presentation describing challenges, best practices, innovations, and a vision for the future in their field. These presentations constituted the first part of the summit, during which the different disciplines taught and learned from each other. The participants were then assigned to mixed discipline groups so that they could develop innovative proposals to address challenges raised by the discipline-specific groups. This white paper was drafted using content from the discipline-specific presentations. A careful review revealed important common themes, values, and concerns for the future of pre-medical preparation across all the disciplines. It also established a sense that the future holds great promise if only we band together to make sure that major elements in medical education currently undergoing significant transition align to better serve society, our patients, and our students.

Introduction

Over 100 years ago Abraham Flexner saw the purpose of pre-medical preparation as aligning health professions education with advances in scientific knowledge, changing societal needs, and an evolving educational system 1. That alignment has been scrutinized ever since, with critique of Flexner's model arising almost as soon as he proposed his paradigm 2. Many educators would argue today that pre-medical preparation serves neither science nor society 3, 4. Some would go so far as to say that the way we have been preparing students for medical school works against the best interests of our patients and their future physicians 5. We have created unrealistic barriers, are not preparing people broadly enough, and are using selection criteria that serve the needs of medical schools more than they serve society. Students are being selected for what they know, as opposed to being selected for analytic skills, communication skills, teamwork, and professionalism 6.



Methods

In June, 2014 the Josiah Macy, Jr. Foundation awarded Icahn School of Medicine at Mount Sinai a grant to host a conference that would study this pressing national problem. We (V.P., M.S., D.M.) chose to bring together many of the key constituents who have a direct role in preparing students for medical school. These constituents included leaders of pipeline programs, undergraduate science educators, undergraduate pre-health advisors, leaders of post-baccalaureate programs, people who have created or direct innovative pathways to medical school, and medical school admissions deans. Our hope was that in learning from each other we could envision a different future for pre-medical preparation in the 21st century.

We selected 5-7 individuals from each discipline based on publication record as well as a reputation for innovation and risk-taking. We also invited leaders from the Association of American Medical Colleges and the Howard Hughes Medical Institute who have been working on issues related to pre-medical preparation. We asked each discipline-specific group to convene by phone and e-mail in the months prior to the conference and create a presentation that would educate the rest of the groups on best practices, existing innovations, challenges, and opportunities for the future in their discipline. The agenda of this National Summit on Pre-Medical Preparation was a series of these presentations, followed by a keynote address and working dinner on Day One. Day Two required the participants to work on two tasks. They would first meet in their discipline-specific groups and turn their Day One presentations into a draft section for this paper. In the second half of the day we reconvened in interdisciplinary groups composed of representatives from each discipline, selected one member as the lead, and asked each group to devise an innovative approach to pre-medical preparation that would address

that group leader's greatest challenge. Those innovations were then presented to all the participants. We adjourned after setting aside some time for discussion and reflection.

This paper is a synopsis of the discipline-specific presentations, each of which followed the same format: framing the discussion, best practices and existing innovations, challenges in the current system and opportunities for the future. We chose to present them in the order in which an applicant interacts with each of these disciplines during the course of pursuing pre-med studies.



PIPELINE PROGRAMS

Framing the Discussion

It is a well-known that the pre-medical pipeline of students who are disadvantaged and under-resourced, and therefore under-represented in medicine (URM), is porous, with old leaks growing larger and new leaks appearing as time goes on 7. What is not always made clear is how large these leaks are, how early the leaking begins, at what stages most of the leaking happens, and what factors lead to this tragic attrition. Figure 1 is a depiction of the loss of talented future physicians. Attrition begins as early as the very start of formal schooling, and the greatest losses occur well before a career in medicine is even be a passing thought in most students' minds. The barriers include poverty, poor nutrition, racism, conscious and unconscious bias, violence, fragmented families, the poor condition of public schools in disadvantaged communities, the social and educational attainment of parents. By the time students reach college they are confronted with pre-med coursework that seems designed to weed them out, 8 in an environment that is intensely competitive and requires enormous financial and social resources for things like MCAT review courses, clinical and research opportunities, advising, and the confidence to ask for help.

In this setting, the task of helping disadvantaged students and students who are under-represented in medicine (URM) navigate these often treacherous waters seems insurmountable. And yet this work is being done, and done well, at a number of institutions around the country. The key to this success has as much to do with language; instead of calling our programs pipelines, which presumes one fixed direction, and irretrievable loss once a leak has sprung, we prefer to describe paths to a career in medicine. Some paths are quite literally the shortest distance between two points, others are more meandering, while still others allow one to purposefully plan an extended educational plan. All lead to the same goal; the lifelong dream of becoming a physician.

Best Practices and Existing Innovations

After many years of trial, error, and an established track record of meaningful success, we have come to the conclusion that the following elements are critically important to building and maintaining a diverse set of paths to medical school for URM and disadvantaged students. We find it interesting that each of these elements is also universally valuable for all applicants to medical school.

- Programs that support an early sense of social belonging and combat stereotype threat using cohort development as well as peer and alumni role models, advisors, and mentors
- Programs that focus on physical, mental, and emotional well-being
- Programs that provide extensive academic support and enrichment
- Early exposure to clinical settings for the sake of professional identity imprinting and professional socialization
- Partnerships with stakeholders, including magnet schools in under-resourced neighborhoods, community colleges, Historically Black Colleges and Universities, hospitals, community-based service groups, and employers
- Consistent and reliable funding in order to support programs and the students who attend them
- Marketing, branding, and public education in order to stress how strongly we believe in the economic, social, and educational imperative of diversity
- Research, clinical, and service activities and curricula that are relevant to minority/disadvantaged students' interests
- Active GME and faculty retention programs in order to extend the pipeline far beyond the medical school years
- More holistic assessment of candidates' attributes in various areas of excellence, with less reliance on science prerequisites, GPAs, and the MCAT.

Targeted partnerships are the key to innovative programs that have successfully produced medical school graduates from URM and disadvantaged communities. Criteria for admission to these programs utilize maximum flexibility in their holistic approach to academic performance, MCAT scores, and other 'traditional' measures of excellence. Additional flexibility comes from varying the time needed to complete training by providing access to early assurance programs and combined or abbreviated undergraduate/MD degrees.

Challenges

Of the many hurdles confronting a pre-med student, five system-wide challenges stand out as being the most formidable.

1) The pool of academically prepared applicants is small and has not grown substantially in recent decades 9. This astounding lack of progress in the face of concerted efforts on the part of so many

stakeholders speaks to the fact that structural and societal, not merely academic or educational, problems are holding us back.

2) Inadequate funding to support existing programs and build new ones; provide living stipends that disadvantaged students desperately need while they are pursuing extra-curricular activities, especially if they are a family bread winner; provide undergraduate, post-baccalaureate, and medical school scholarships and relieve an already crushing debt burden.

3) An appreciation of just how early in the growth and development of a student one needs to intervene. Given the societal pressures and disadvantages we have mentioned, it makes sense to reach back as far as grade school in an effort to level the playing field for children who have potential but would otherwise never have the opportunity to pursue a career in health care.

4) A lack of confidence on the part of most medical schools to forego the MCAT entirely or at least use it in a much more thoughtful and holistic manner. The MCAT stands in the way of our ability to genuinely rethink pre-med science requirements and continues to disproportionately deter URM and disadvantaged students.

5) We are failing to make the case to the general public that attracting a far more diverse physician workforce has a strong economic imperative; will help meet the clinical and health policy needs of the nation; will enhance the learning experience in medical school; will greatly stimulate creativity and discovery in the laboratory; is socially just.

Final Thoughts

A concerted and coordinated effort across disciplines, including community and industry partners, is the only way that we will be able to achieve our goal of creating educational opportunities for those in greatest need of them. Diverse paths to and through medicine, from the very start of formal schooling all the way through residency, fellowship, and years in practice will enhance our ability to attract a wider variety of students to the medical profession. This will require less rigid reliance on the MCAT and on undergraduate science courses that exist in silos, and more reliance on an educational model that is based on competencies and holistic measures of performance.



UNDERGRADUATE SCIENCE EDUCATORS

Framing the Discussion

An undergraduate education for future physicians should place science content knowledge within the context of the changing research landscape and societal needs. Science faculty should foster interest in and a sense of wonder about the natural world, and should at all costs avoid creating artificial barriers to students' genuine interest in studying science and pursuing a medical career. Too often students passionate about medicine turn away from that path because of negative experiences with rote memorization in required prerequisite courses. The ideal premedical education will enable students to develop to their full potential and master a set of competencies that will allow them to become highly effective health care professionals.

Best Practices and Existing Innovations

Current pre-medical instructional practice at most undergraduate institutions includes multiple limiting features. These include courses that teach memorization of facts rather than a deep understanding and ability to apply concepts, courses that lack relevance to student experiences or engage students in seemingly pointless activities (e.g. "cook book" lab courses in which students do prescribed "experiments" whose outcomes are already known), and minimally supportive student environments that do not allow all students to reach their full potential. Existing pre-medical curricula also limit diversity by specifying a circumscribed path that makes it difficult for students to become doctors if they do not enter the pre-medical program in their first semester at a four-year college. Below we outline best practices that are overcoming these challenges.

Recent studies of evidence-based teaching methods should guide classroom experiences. Active learning, including flipped classrooms, case studies, individual response systems, and group work should be incorporated into science pedagogy to maximize student learning [10](#), [11](#), [12](#). Assessment of any change is essential because not all active learning has proven efficacy and implementation is resource intensive.

Authentic research experiences blur discipline-specific boundaries and provide opportunities to develop more meaningful competencies by integrating material across disciplines. While the meaning of "authentic" can vary in different contexts, it is generally defined as experimentation that addresses a meaningful question with no known correct answer. Students should participate in authentic research as early as possible, whether in problem-based course laboratories or in research laboratories. These experiences enable students to strengthen their quantitative reasoning, analytical skills, written and oral communication, and ability to work in teams. Projects need not be limited to the traditional "hard sciences", but can address relevant research questions in the social, behavioral and population sciences as well.

Interdisciplinary integration of science content across the pre-med curriculum allows students to develop a more holistic understanding of the different areas of science and appreciate the applicability of what they are learning. Promising examples of integrated science content include courses that

combine calculus and population biology, organic chemistry and cell biology, or physics and life sciences 13. While departmental barriers to integration have historically been both numerous and high, today's undergraduate incentive to improve efficiency by eliminating redundancy and reducing the total number of courses a student has to take will work in our favor. The move towards competencies is timely and will provide further incentive in the long run to restructure pre-med coursework.

Peer learning, learning communities and cohort models have been shown to provide essential support for most students 14, and are particularly helpful to students underrepresented in STEM (Science, Technology, Engineering, Math), enabling them to persist toward their goals. A group identity provides an opportunity for personal and professional socialization, as well as peer and near-peer mentoring and advising.

Some students develop an interest in medicine late in their undergraduate education, or even after graduating, without completing the traditional medical school prerequisites. Post-baccalaureate programs provide a way to complete prerequisites quickly. Because of the need to accommodate students with a breadth of prior experiences, innovative pedagogy that integrates course material and breaks down traditional barriers may be implemented more easily in these programs than in traditional undergraduate pre-med programs.

Challenges

Undergraduate

Faculty in undergraduate and medical school science departments function under similar constraints. Changing or integrating courses and curricula requires an enormous investment of time, energy, resources, political support from the top down and substantial buy-in from the bottom up. Faculty who have been teaching successfully for many years may be risk-averse and are often reluctant to move away from the 'sage on stage' model that has served them well and was the way they were taught. Faculty also struggle with the inevitable trade-off between content depth and breadth that comes with any change, especially integration. There is rarely an incentive structure that rewards curricular innovation. Teachers are faced with students who arrive at college with a wide range of preparation for the sciences, many of whom need supplemental instruction or remediation. The traditional path, whereby students schedule their premedical courses in order to be able to take the MCAT at the end of their junior year, apply to medical school as seniors and hope to matriculate the fall following graduation, is not ideal for many students, particularly those with weaker pre-college preparation. Advisors, instructors, medical school admissions personnel and, most of all, students, need to become more aware of the value for many students of one or more "gap years" between college and medical school.

Medical School

Along with the MCAT, medical school admissions requirements are driving the undergraduate pre-med curriculum, thereby defining which students succeed. For example, while a basic level of competency in organic chemistry underlies understanding biological processes and the mechanisms of therapeutics,

there is little evidence that performance in the traditional sequence of two semesters of organic chemistry is highly correlated with proficiency as a medical student or a physician. Yet “orgo” is commonly used as a “gate keeper” or “weed out” course that eliminates some potentially excellent physicians from the pre-medical student population [8](#). To the extent that medical schools admissions requirements act as filters to create rank-ordered lists of candidates, rather than reflecting competencies that underlie the effective practice of medicine, no set of innovations, however desirable, is likely to prove successful in better preparing future physicians. Although not universally embraced by science faculty, the HHMI/AAMC Scientific Foundations for Future Physicians report emphasizing undergraduate competencies rather than prescribed courses is an opportunity to create more flexibility in the curriculum and in the admissions process [15](#).

The AAMC has made extraordinary efforts to reform and update the MCAT [16](#), [17](#), [18](#). These reforms have been heartily welcomed by many undergraduate science faculty. There is also a perception among some faculty that the HHMI/AAMC focus on integration and competencies seems more like a means of ‘teaching to the test’, as opposed to a genuinely better way of educating pre-med students. For faculty in either camp, the ambiguity surrounding the new MCAT and new competencies means that no one is certain how medical schools will describe their requirements, or how pre-med students can conceivably be expected to meet them if they vary from school to school. Finally, how will proficiency in a given competency be evaluated?

Opportunities

There is no better time than the present for aggressive innovation. The forces for change are aligned like never before and include the move from rote memorization to competency-based education; the focus on holistic admissions; advances in integrating science and clinical practice (e.g., Systems Medicine and Systems Biology); advances in learning technologies and education research.

We must take advantage of this unique opportunity in our history by 1) continuing to move from courses that require rote memorization to learning experiences that require critical thinking, problem-solving and real world application, 2) improving communication among science educators within and across departments at any given school, between institutions in the form of peer-reviewed dissemination, and with students. One possible venue would be dedicating an issue of Academic Medicine to high quality education papers from diverse undergraduate disciplines, and 3) making sure that new approaches to undergraduate science education are evaluated by formative and summative, qualitative and quantitative assessment.

Final Thoughts

Progress in pre-medical preparation has been and continues to be made, as evidenced by the ISMMS/Macy Summit, the AAAS Vision and Change meetings [19](#), HHMI education initiatives [15](#), formation of new associations (e.g. PULSE [20](#)) and conferences (e.g. SABER [21](#)). We need to engage constituents and stakeholders at all levels in order to help them overcome their barriers: institutional and departmental silos, faculty inertia, the enormous pressure to maintain research funding that leaves little time for educational innovation, and students who often prefer memorizing facts as the path of

least resistance. A critical factor will be our willingness to embrace uncertainty as together we change the face of medicine in this century.



PRE-HEALTH ADVISORS

Framing the Discussion

If the rigid ‘pre-med track’ is not already a relic of the past, it is at the very least rapidly losing ground. The new paradigm that is emerging allows for many different paths to medical school. Despite this, many constituents, including undergraduate faculty, students and their parents, and medical school admissions committees continue to think in terms of the pre-med ideal; a student who, from the time they complete high school, is determined to pursue medicine, has a major in the biological sciences, does just enough extra-curricular activity to fill an application, does exceptionally well on the MCAT, and takes as little time as possible to accomplish all of the above.

Best Practices and Existing Innovations

The needs and best practices of a successful pre-health advising office include a clear vision, mission, values, and statement of philosophy; adequate facilities; administrative support and personnel with strong advising skills; access to technology and the resources to create up-to-date advising materials; funding for professional development; meaningful relationships with institutional leadership, faculty, and alumni; the ability to continuously assess and respond to outcome metrics.

Pre-health advisors are uniquely positioned to shape the culture of undergraduate pre-medical education. Their activities can include

- teaching courses and offering workshops
- collaborating with undergraduate faculty on curricula and academic support
- partnering with admissions deans, medical school staff and faculty to bring speakers to campus or plan trips to medical schools
- creating peer mentor programs to harness the power of older students’ experiences
- participating in bridge programs aimed at matriculating and retaining a more diverse group of undergraduates
- helping create post-baccalaureate options for students who do not or cannot pursue the traditional pathway to medical school
- facilitating communication within and across institutions.

Foremost, pre-health advisors serve as repositories and transmitters of accurate information for students interested in health careers; challenge applicants to understand themselves, their values, and their goals; advocate for students; facilitate thoughtful, informed, and honest applicant decisions that have integrity; partner with applicants, advisor colleagues, and admissions deans in order to better serve the health professions and society; appropriately and fairly represent students to professional schools; teach and role model respect, compassion, and good listening skills.

Challenges

The challenges to effective pre-health advising are more complex than ever before and are stressing a system that is already finding it difficult to keep up with increasing demands (Table 1). Many of the challenges are a result of roles that can engender significant conflict. For example, advocating for students while critically evaluating them; encouraging students to use their undergraduate years for learning and exploration while ensuring that they meet their requirements; encouraging students to aim high while being honest about each student's own limitations.

The pre-health office is the repository of comprehensive, reliable, and easily accessible information, but must also contend with the growing number of external, often inconsistent, and sometimes unreliable sources of advice and information, such as parents, paid peer consultants, physician family members or friends, social media, and companies that have historically exclusively provided MCAT preparatory courses.

As the number of paths to medical school has expanded, so have the number and variety of students seeking pre-health advice. In addition to 'traditional' pre-med students, there are now an increasing number of early assurance programs; students transferring into an institution as a pre-med from other colleges; students applying to enhancement post-baccalaureate and/or Master's programs; alumni applicants who choose to pursue a post-baccalaureate course of study after several years in another profession; URM or disadvantaged students who have entered college from pipeline programs for URM or disadvantaged backgrounds.

Perhaps our biggest challenge is convincing medical educators that their explicit and implicit messages regarding premedical requirements and the available paths to medical school carry enormous weight with applicants, as well as everyone who teaches and supports them. For example, although innovations in MD curricula and the introduction of the MCAT2015 are well-intentioned, the inconsistent and sometimes erratic interpretation of these changes by medical school admissions committees has led to a situation where advisors and students find themselves trying to adapt to the future while continuing to accommodate present requirements.

Opportunities

Many existing innovations in pre-health advising are the result of aligning goals and values and developing close working relationships with undergraduate faculty, senior leadership, and medical school faculty or staff. In every case the pre-health advisor needs to be seen as a partner, not simply a

gatekeeper, so that together we can work for the best interests of our students and the best interests of their future patients.

Maximizing the benefit from such relationships will require a systematic and concerted effort to share resources and information so that all pre-med students, including those at schools without pre-health advising, can benefit. This could involve creating a national web-based, open-access, reliable source of advising.

Final Thoughts

We need a paradigm shift in the way medical schools define their expectations of applicants. In response to MCAT 2015, the current environment has left pre-med students and their advisors confronting erratic and inconsistent requirements. As a result many students are applying later, incurring more debt, suffering from more academic and emotional stress, and further straining a system that was already struggling to keep up. Instead, medical schools should take their cue from the 2009 AAMC-HHMI Scientific Foundations for Future Physicians report, focus more on the competencies they're looking for in applicants, and less on how any given student has reached that educational endpoint. If we are to attract, retain and educate a more diverse population to become our future physicians, we need to focus on far more than course requirements and MCAT scores.



POST-BACCALAUREATE PROGRAMS

Framing the discussion

Post-bac programs cater to two distinct groups of students: 'Career Changers' and 'Record Enhancers'. Career changer programs act as a conduit for entry into the medical profession for established professionals in other fields. These programs enrich the medical profession by introducing students with a diversity of life experience and training to the field of medicine. Record enhancement programs provide supplemental training in the basic sciences and additional reinforcement of the academic skillset necessary to be successful in medical school. Post-bac programs, especially record-enhancing programs, also help address the nation's dearth of pre-health advising for students with limited or no access to it. These programs provide professional premedical advising and a support system to a more ethnically and socio-economically diverse population of students. As a result, post-bac programs enhance and diversify the health care workforce 22.

Best Practices and Existing Innovations

The best post-bac programs are often tailored to specific student needs depending on their cohort's focus. For example, programs for record enhancers provide more basic skill-building, while programs for career changers provide more transitional support. Basic skill building includes time and stress management, test-taking strategies, and alleviating test anxiety. Examples of transitional support are workshops to reinforce math skills and free tutoring for students who are encountering science for the first time. All programs encourage diversity and, as a result, strive to provide tailored mentorship and individualized advising. An increasing number of post-bac programs provide more streamlined entry into medical school via linkage relationships with specific medical schools that allow students to apply to those medical schools and receive conditional acceptance, and in some cases full acceptance, without having to take the MCAT. These linkage arrangements enable post-bac students to skip the year during which students typically apply to medical school ('glide year').

Since post-bac programs are faced with the challenge of providing students with a comprehensive science preparation in a relatively compressed timeframe, several programs have created accelerated, inter-disciplinary science courses, as well as science courses with more clinical correlates, service learning, and integration with the social determinants of health. As a result, post-bac programs have been able to adapt their courses and academic support more rapidly to address the new pre-medical requirements and the new MCAT.

Challenges

Despite this flexibility and more rapid adaptation, changes in the MCAT present an extraordinary challenge to all post-bac programs, in particular to one-year programs. The variety of topics and extent of subject matter now covered on the new MCAT, as well as the challenge of transitioning a very diversely prepared cohort of students to the study of science, may present an insurmountable hurdle. Exacerbating the problem, the difficulty of getting medical schools to accept competencies instead of additional course requirements significantly inhibits curricular creativity.

Another fundamental challenge to students pursuing a post-bac course of study is the cost of these programs. Undergraduate institutions typically do not offer any scholarships or subsidized school loans, nor are students eligible for most federal and state financial aid, since post-bac programs are not degree granting. Students must bear the cost, which can be as high as full tuition at a private university and can disproportionately excludes students from disadvantaged backgrounds. In the worst case, some post-bac programs are seen by their host institutions as a means of generating substantial tuition revenue.

Finally, it has long been the case that applicants struggle to distinguish quality programs from a wide range of options. Some programs do not share data about their students' attrition rates. While most programs do report their outcome metrics to the public, the lack of standardization and definitions of these metrics results in misleading statements that can be nearly impossible to navigate for students trying to evaluate the various programs.

Opportunities

Post-bac programs are perfectly positioned to continue providing paths to medical school for a more diverse and non-traditional student population 23. As educators we must find a way to lower the cost of these programs by providing more meaningful financial aid so that students who are disadvantaged, first generation, or URM are not dissuaded from taking this approach and joining the medical profession.

These programs also create opportunities for educators who want to adapt traditional science courses into educational experiences that are more integrated, competency-based, and clinically relevant. Embracing the competencies and eliminating myriad course requirements will certainly allow post-bac educators to experiment with new models of teaching. Ironically, a competency-based approach may also make students and medical schools more dependent on the MCAT since there will be fewer quantitative academic markers (like course grades) to distinguish students from one another.

The time is also right for us to produce a list of criteria, best practices, and outcome measures that must be public knowledge and can be used by prospective students in evaluating post-bac programs.

Final Thoughts

We are at a critical moment in the history of post-baccalaureate preparation for medical school. All the variables that for years were stable are now in flux, with some acting as competing forces. Will medical schools recognize topic competency without any evidence of a distinct course in said subject? If so, how can we help students demonstrate that competency? Are undergraduate and post-bac programs responding by creating integrated, accelerated, clinically relevant courses? Will moving to competencies make us more dependent on the MCAT, which in turn will mean more dense curricula or extending post-bac duration? And what of the trend among post-bac programs with linkages to remove the MCAT requirement entirely?

Depending on their response to all these questions, post-bac programs have the opportunity to be at the vanguard of this paradigm shift in pre-medical education while also substantially enhancing the diversity of the health care workforce.



INNOVATIVE PATHWAYS

Framing the discussion

Innovative targeted pathways to, or in, medical school allow educators and institutions to express their vision and values, aligning them with societal needs. Such programs may focus on specific groups of

students (for example, under-represented minorities or those committed to their local communities). They can also focus on producing a specific type of physician (for example, primary care physicians, physicians who work with underserved populations, or physician-scientists) regardless of student background. The key to these programs is to be mission-driven, focused on the needs of society and based on the vision and values of the institution in which they're based.

Best Practices and Innovations

The keys to the development and success of innovative pathways include the timing of recruitment (anywhere from middle and high school to post-doctoral work); advising and mentorship; socialization into the profession; and the focus and pace of the curriculum (from remedial to accelerated; population health or translational science). These innovative pathways are not appropriate for all students interested in the medical profession. It is important to identify specific students likely to be successful and carefully track their outcomes.

One approach to innovative pathways involves modifying traditional admission requirements 24. Because a number of these programs select students who are high school seniors or early in their college years, the usual metrics of grade point average (GPA) and MCAT scores are given wider berth, with an increasing number of programs not even requiring the MCAT for admission and some using a 'sliding scale' depending on GPA and other personal, demographic and social factors. These pathways often consider other variables such as high school grades, SAT or ACT scores, and AP examination results. They are also typically far more holistic in the value they place on medically-related activities, community service, geographic diversity, investigative work, previous advanced degrees and life experiences. There is a strong emphasis on recruitment of under-represented minorities, especially from underserved communities, in most innovative pathways because of the close alignment of institutional mission and societal need.

Since innovative pathways tend to cater to smaller cohorts of carefully selected students, they have the ability to provide students with curricular and extra-curricular elements that might otherwise be very difficult to offer to an entire incoming class. These elements include 1) summer pre-matriculation programs that teach teamwork, study skills, and provide socialization and identity formation, 2) meaningful service commitments, often around primary care, that include exposure to community health centers and emphasize patient advocacy, 3) general professional education integrated into the pre-health curriculum around topics such as psychology, philosophy, narrative writing, social determinants of health, human rights, and development of the US and its population, 4) competency-based education with transition and advancement milestones, 5) individualized educational plans and advising, and 6) capstone senior courses that integrate the biological and social sciences.

In an effort to fill the workforce need for physician-scientists, accelerated career development programs are also available for PhD students interested in obtaining a Doctor of Medicine degree 25. Success in these programs requires demonstration of scholastic aptitude (that is, higher GPA and MCAT scores), a track record of investigative work, and previous publications demonstrating the student's commitment

to scholarship. The curriculum is typically more focused, with less duplication and greater integration between lab work and clinical experiences, and relies heavily on mentorship in career development.

Challenges

Given the unique nature of these pathways, they rely heavily on the commitment and good will of teaching faculty, chairs, and deans. For example, a pathway that focuses on a particular student group or outcome that is highly valued by a current dean may be in serious jeopardy when that dean departs and a new leader has different priorities. Similarly, federal, state and external funding can be unpredictable as the priorities of foundations and governments shift over time. It is critically important to educate lawmakers, students, peers and communities about what societal needs are being met by these pathways, what outcome measures are being used to demonstrate performance, and how these outcome measures translate into tangible benefits for specific constituencies and society as a whole.

Another major challenge is attrition. The combination of uncertainty about career choice, academic struggles, parental pressure, and competition from other medical schools can lead to high attrition rates. This attrition can sometimes be exacerbated by lack of curricular integration in the premedical years, poor coordination between the premedical and medical phases, and concerns about adequate preparation for medical school and licensing examinations.

Opportunities

The time is right to rethink many of the century-old pre-medical paradigms. With the increased attention being paid to competencies, population health, inter-professional education, and the early integration of clinical and community-based experiences, it is clear that many innovative pathways are perfectly positioned to lead a paradigm shift that mainstream programs will eagerly follow. This will certainly lead to improved coordination between pre-medical and medical curricula, and will hopefully allow innovative pathways to prosper as resources are redirected to these progressive approaches.

The time is also right to rethink how much time it takes for a student to traverse the medical educational pipeline from start to finish. Fast track innovative pathways that are mission-driven and provide a clear path from the undergraduate years through medical school, residency, and career opportunities will be very attractive to some students and some institutions.

Finally, it is time to reconsider the metrics we are using to measure the success of these students. Focusing on academic performance to the exclusion of other accomplishments will never allow us to address societal needs. The health of our communities is the gold standard by which our pathways and our medical schools should be measured. A medical school's advocacy, community service, clinical outcomes, and biomedical discoveries that are genuinely applicable to our patients are no less valid measures, and are arguably a better reflection of what we hope to achieve in training tomorrow's physicians.

Final Thoughts

Measuring success has never been more important, and the stakes have never been higher. Society demands that the privilege and responsibility we have been given to recruit, train, and graduate future generations of physicians translate into significant improvements in the health of our nation. The short term metrics we have been using, including grades, USMLE scores, selection to the Alpha Omega Alpha (AOA) and Gold Humanism societies, and residency placement are no longer adequate. We need to force ourselves to measure more relevant and meaningful outcomes. How do we measure success in residency or in practice? How do we assess teamwork and leadership skills? How many of our trainees end up in primary care fields, how many are practicing in underserved areas, and will analysis of 'big data' reveal patterns that will help us understand their impact? How many are devoting their lives to being physician-scientists, and what metrics are we using to measure their success? Is it important to ask our students, our doctors and our physician-scientists about their own satisfaction; when they look back from different stages of their careers, would they do it again?

The answers to these questions will help us develop more valid and reliable means by which we can determine whether our innovative pathways, and medical education in general, are truly serving the needs of our patients and communities.



MEDICAL SCHOOL ADMISSIONS DEANS

Framing the discussion

This work is about developing a fair, credible, professionally accountable admissions process that contributes to the creation of a physician workforce that is able to comprehensively address the healthcare needs of an increasingly pluralistic society. The selection of candidates for medical school is an important step in that continuum. It does not exist in a static isolated manner, but rather as a dynamic, constantly evolving effort to respond, and lead, to change. Preparation for a career in medicine is a continuum of life experience, academic work, and other factors, starting with the families and communities in which we are born, that extend into and through medical school, our careers as scientists and physicians, and the lives we lead as citizens and contributing members of society.

Best Practices and Existing Innovations

Societal demands on the medical profession mandate that admissions programs move beyond the traditional model of applicant assessment based in a narrowly focused view of academic metrics in the natural sciences 26. Admissions committees must move to a holistic review; a mission driven, institution-specific model that comprehensively evaluates candidates for the study and the practice of medicine. Holistic review broadens our previous notions of excellence by reflecting a more expansive

view of what constitutes the base of knowledge, skills, and experiences required for success as a physician.

Medical schools are at different stages of the transition from rigid academic performance and course requirements to broad academic expectations and competency-based admissions. This transition can be confusing, subtle, idiosyncratic, and we are struggling as a community with how to support our applicants through this process. We like the systematic consistency of Organic Chemistry grades and the MCAT, but don't want to rely on a single high stakes exam that despite best efforts is socially, culturally and economically biased [27, 28](#).

In addition to an aptitude for and a sound understanding of the natural sciences, medical students must have broad academic preparation in the social and behavioral sciences, and a life experience that allows them to respond to and connect with the diverse and complex needs of individuals and communities. In the same way that social, cultural, political, ethnic, racial, economic, and linguistic determinants are very powerful influences in health and disease, it's about time that we emphasize these elements in the way we assess our applicants.

One example of a best practice is the way in which some schools have already developed methodologies for assessing personal characteristics, traits, and behaviors using Multiple Mini-Interviews [29](#).

Another best practice revolves around the importance of educating ourselves and members of our admissions committees. As committed and passionate as we may be, Admissions Deans, interviewers and committee members are hard pressed to avoid their unconscious biases and over-reliance on stereotypes. Training, transparency, and teamwork are the best weapons we have to combat these forces. Committee members must be educated and indoctrinated, and committee composition must reflect an institution's values, priorities, and the needs of our surrounding communities.

The inherent danger of holistic review is that we will succeed in bringing to medical school a 'new' student who will fail in an 'old' medical school. Admissions cannot be the tail wagging the dog. We need to make sure our Curriculum and Student Affairs colleagues are moving ahead with us. Holistic review will, by definition, be mission-driven and institution specific. It will also enhance diversity and inclusion by influencing from whom students learn, by whom they are challenged, and with whom they will practice.

Challenges

- The move from courses to competencies may lead to increased academic pressure that increasingly narrows the scope of experiences and opportunities in other parts of collegiate life, further limiting a student's ability to experiment and take risks in their studies.
- Among the many hurdles we have to overcome, we struggle with the homogeneity of the applicant pool, the restrictive legal environment that surrounds the recruitment of candidates who add diversity, and the astronomical and escalating cost of attending medical school.
- Admissions committees do not currently have adequate approaches for the integration of nontraditional academic experiences into our assessments, nor do we have methodologies to

provide validated, reliable, feasible, and acceptable metrics for comprehensive assessment of applicants. Some of the domains we wish to consider in the holistic evaluation of applicants may never lend themselves to quantitative assessment. Very few tools have been validated at a national level with large databases, and each of us is dealing with a very small pool of applicants in a single school and a highly specialized environment. Current metrics only provide an aura of objectivity, which leads to push back from basic science faculty (who worry about providing remedial undergraduate science content), clinical faculty (who find themselves having to cover science that basic scientists couldn't), medical education leadership (who worry about encroaching schedules and lecture hours), and administrative leadership (who worry about high stakes and very public rankings). At best we can make reasonably reliable decisions that make good sense, based on the tools we have at our disposal.

Opportunities

- MCAT 2015, which includes a test of academic preparation in the social and behavioral sciences, may be an important tool in the effort to shift our focus to more qualitative assessments of academic experiences and competency-based evaluation. However, each admissions committee must, in the context of its own institutional culture, develop an approach for incorporating this information in a multifactorial model for applicant assessment. In doing so, admissions leaders must continue to challenge the status quo and relentlessly promote change, which can be a lonely and threatening job, especially when there is resistance and reluctance from academic and administrative leaders who are risk averse.
- Harnessing the power and social message of holistic review may allow us to leverage private philanthropy and other resources to facilitate expansion of the medical school pipeline. Institutional resources will never close this gap.
- We must collectively commit to transparent public disclosure of the admissions process, selection factors, and important features of the student experience at each medical school. We need to say what we mean and mean what we say. In not doing so we are confusing ourselves, applicants, and the public, and preventing applicants from making informed choices.

Final Thoughts

Overcoming the challenges and taking advantage of the opportunities we have enumerated will require, above all, expansive collaboration between pre-health advisors and admissions officers. We all serve patients and society and must work together as partners, overcoming institutional loyalties in an effort to serve the greater good by driving paradigmatic change in pre-medical preparation.



Lessons Learned

In many spheres of medical education and medical practice we have learned that inter-professional teamwork is the key to unlocking our potential for solving the thorniest problems. That very same lesson is arguably the most important outcome from this national summit on pre-medical preparation. Bringing together different disciplines to study and reflect on the challenge of preparing students for medical school has taught us that we are all working towards the same goals, we are all confronted by the same challenges, and our vision for the future is already very closely aligned.

Prior to the summit each discipline worked on its presentation without any knowledge of what other groups were preparing. Despite that, a number of universal themes emerged (Table 2) that helped us realize how valuable it would be to work on these goals as a unified front instead of in isolation.

In order for this Summit to have the greatest possible national impact, we realized that we needed to create a groundswell of support and convince policy leaders that this is a major priority in medical education. In order to accomplish this we chose the following objectives:

- Write and publish a white paper on the current and future state of pre-medical preparation
- Provide small seed grants that would allow each Summit participant to partner with someone who did not attend on an innovation in their discipline
- Present the proceedings of the Summit at each discipline's regional and/or national meeting
- Host an annual conference focused on this topic
- Share our impressions and concerns with the public in the lay press



Conclusion

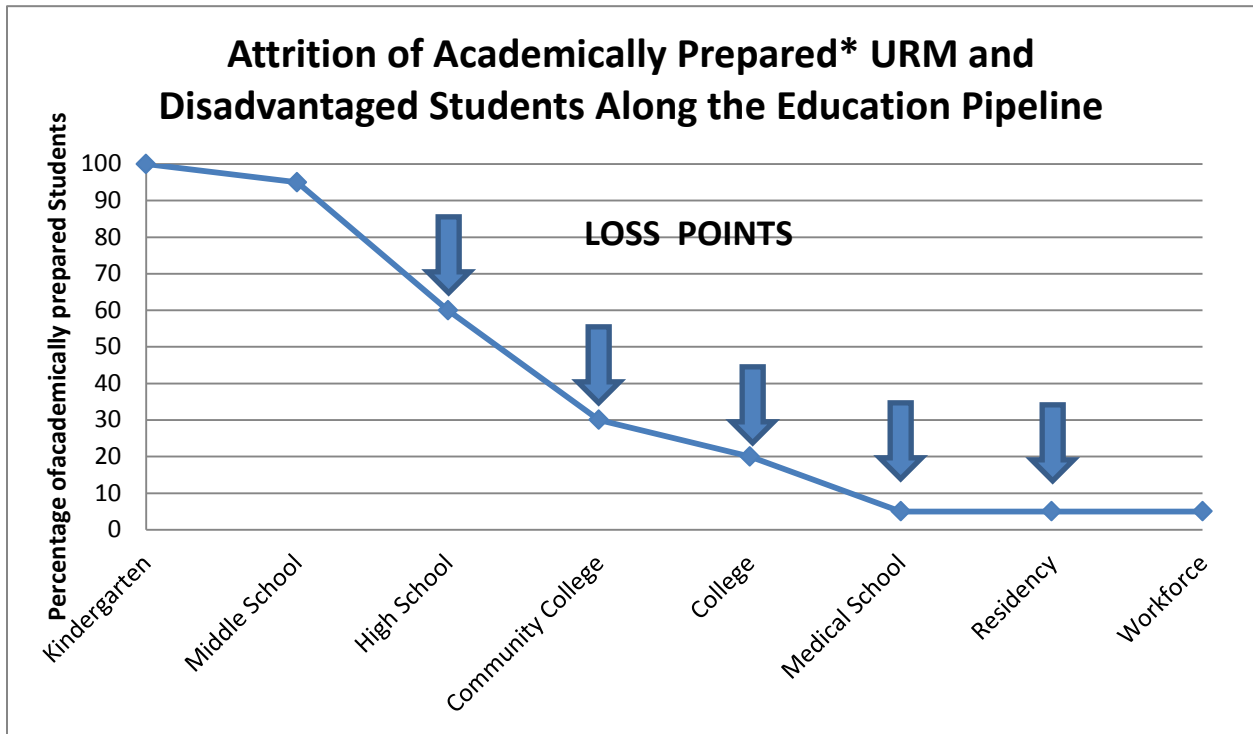
It is clearer than ever that we need to focus on what's missing from pre-medical education: academic rigor with less grades-driven competition; curricular flexibility and opportunities for self-directed learning; coursework that is more closely aligned with society's needs; a variety of paths to medicine that will enable us to achieve greater diversity in our student bodies and the American health care workforce. The 20,000 students who enter medical school every year are remarkably accomplished, but for the most part have achieved great things despite, not because of, their pre-medical preparation. Our current model subjects smart, creative, passionate students from across the broad spectrum of American life to an educational experience that detracts from their ability to be independent, self-directed, collaborative learners. It does not nurture the attributes they will need to care for the underserved, perform breakthrough research, and fix our health care system.

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Figure 1.



*Academically prepared - The student has acquired foundational knowledge, exposure and engagement related to the study of medicine, and demonstrates the commitment and dedication to achieve this goal.

Table 1. Key Areas of Concern

Premedical Requirements

- Increasing number of universal and school-specific course requirements
- Lack of clarity in individual medical school requirement policies (e.g., AP credit)
- Already inflexible undergraduate curricula
- Pressures on undergraduate faculty and departments in response to MCAT 2015
- Dramatic increase in students pursuing summer and online coursework

Premedical Culture

- Increased student uncertainty, anxiety, stress, and other mental health issues

- Increased peer and parental pressure
- Students with “blindness” or a “checklist mentality”
- Financial pressure driving student focus on stable, lucrative careers

Pipeline and URM Populations

- Defining and identifying the populations in need (minority, disadvantaged, first generation, Deferred Action for Childhood Arrival, etc.)
- Engaging students early to encourage use of advising, support services, and “safe havens” (e.g., minority affairs office) by demystifying the work of the Pre-Health Office
- Perception of “intrusive advising” of students in difficulty
- Identifying and coordinating support from “stakeholders” (senior leadership, alumni, medical school deans)
- Students with financial need beyond traditional tuition, room and board (students who need to work)
- Increased prevalence of ‘stereotype threat’ and ‘imposter syndrome’
- Questionable acceptability of community college and other course work outside of the primary institution discriminates against under-represented students

Table 2. Universal Themes

- The primary purpose of pre-medical preparation is meeting societal needs related to health care for all and scientific discovery
- We must develop more diverse paths to medical school, with more flexible and more holistic admissions requirements
- We must focus on enhancing the diversity of the physician and scientist workforce
- Using the MCAT as a key criterion for admissions and national school rankings does more to undermine the pre-med process and the education of physicians in this country than any other single factor
- By establishing requirements and priorities, medical school admissions committees set the tone and the standards, and therefore must be the drivers of change