A Proposal for a Shared Medical School Curricular Ecosystem

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Abstract

New digital platforms are transforming learning in higher education and providing high-quality education content at little or no cost. Educators can now reach large, even global audiences. Yet, many medical schools continue to develop and maintain custom but duplicative curricular content despite having limited faculty and financial resources. In addition, medical students are faced with a multitude of potentially unaligned curricula driven by the school, national licensing exams, and the students' own perceived clinical training needs. The authors propose the creation of a common curricular component ecosystem that is developed around consensus-built foundational learning objectives aligned with core competencies that must be acquired by all students graduating medical school. Identifying and developing common curricula with standardized learning outcomes ideally should involve leading medical education, accreditation, and certification bodies in the United States. Curriculum component standards will be necessary to enable curriculum development, sharing, and adoption at scale. A shared medical curriculum ecosystem would free up faculty time to develop high-value teaching activities at individual medical schools. Students would benefit from a consistent education experience that better aligns with national licensure exams. A shared, core curriculum system could begin to bend the cost curve for medical education in the United States and scale internationally to help address the increasing global shortage of health care workers.

Over the past decade there has been a digital transformation of learning in K–12 and higher education.[1] A range of high-quality and diverse educational content is now instantly available and widely accessible at low or no cost through platforms hosted by edX, Coursera, Khan Academy, and many others. These digital learning platforms, including the massive open online course variants, are characterized by the ability of educators to "create once and use many times." Some online courses enroll hundreds of thousands of students, and a well-developed education video can be viewed by millions of learners.

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Education Redundancy in the Digital Age

The 2010 Carnegie Foundation report *Educating Physicians: A Call for Reform of Medical School and Residency* appealed for renewed efforts in education innovation to standardize learning outcomes while providing opportunities for individualized learning.[2] This seminal publication cited education technologies such as online learning and simulations as examples of such necessary and creative advances. Nevertheless, medical education has been slow to realize the potential of such digital systems to share educational content while reducing cost. Many medical schools in the United States expend substantial resources developing and maintaining instructional materials with various learning objectives in their own undergraduate medical curricula without considering the fact that these efforts are duplicative of those at other schools.

Further, many of these same schools operate on tight budgets and currently face a challenging financial landscape, characterized by declining clinical reimbursements and federal research funding. In this context, overburdened medical educators are being asked to do more with less time and fewer resources. This can lead to unexpected curricular gaps, uneven instructional resources, inconsistent pedagogy, mismatches between faculty and teaching tasks, reduced engagement opportunities with students, and ultimately faculty burnout. In this resource-scarce environment, maintaining a custom set of curricular materials for each school, particularly in foundational areas, seems inadvisable.

Curriculum Misalignment

Medical students enter school as motivated learners who recognize that the health and welfare of their future patients depend on their acquiring the appropriate knowledge, skills, and behaviors. They generally assume that their teachers, school administrators, and licensing bodies agree on a corpus of knowledge that is foundational to their education. But as they compare notes with peers in schools across the country, they soon realize that a consensus-based curriculum does not exist. They also learn that the examinations created by the National Board of Medical Examiners (NBME) are the highest-stakes tests that they will take in medical school. For some residencies, their scores on Step 1 of the United States Medical Licensing Examination (USMLE) will determine whether they are even interviewed. Therefore, not surprisingly, the students perceive the content tested on this examination to be, by default, the common national curriculum.

For students, perceived misalignment between what is tested on USMLE Step 1 and what is taught in the relevant courses at their medical schools becomes a source of anxiety, stress, and even misguided outrage. Students may feel conflicted between learning what faculty at their schools teach, learning what likely will be tested on their national examinations, and preparing for their clinical training. Deciding which of these three curricula should be prioritized fuels that frustration. Students frequently respond by supplementing or even substituting the school's curriculum with third-party resources to identify essential knowledge, at least for the USMLE.

A Proposal for a Common Curriculum Ecosystem

To address these vexing challenges, we propose the creation of a common curricular component ecosystem. This curriculum collection should be developed around consensus-built foundational learning objectives and concepts aligned with core competencies that must be acquired by all graduating medical students. A curricular component could be as small as a single video or as large as a course. Faculty could access this common set of learning objects to build and develop their own distinct curriculum. This is not a new thought. Four years ago, in a Commentary in *Academic Medicine*, one of us (C.G.P.) proposed "the creation of a medical school collaborative" to begin to develop reusable curricular materials.[3] We recently completed a proof of concept in which four medical schools collaborated to define, create, and implement a foundational medical school course focused on microbiology, immunology, and infectious diseases. We demonstrated that it was feasible for medical schools to collaborate on curriculum development without compromising student performance or student satisfaction.

We are not suggesting the development of a universal one-size-fits-all curriculum. Every medical school is unique with different missions reflecting the values, interests, and needs of their stakeholders and locale. Therefore, every curriculum, while sharing substantial overlap, should be distinct with tailored education goals, pedagogic approaches, additional learning experiences, and assessments reflecting that mission. Each school would select, organize, and modify the common curricular elements that would serve as a foundation for their curriculum. We believe that this would be a wiser use of schools' limited faculty and financial resources than the current model of developing curricula from scratch at each institution.

Defining and Building the Common Curriculum

What constitutes a common curriculum component is a challenging question. Ideally, the decision to identify such content concepts would be based on a set of guiding principles. These principles might include the requirement that core content fulfill one or more types of criteria (Table 1). Regional, cultural, and socioeconomic factors also will influence the application of these principles. Clearly "the devil is in the details," and we believe that it is only through a process that engages education experts in basic science, clinical science, and population health science, with representation from the broad specialty and subspecialty areas in medicine that an appropriate, scientifically rigorous, patient-centered common curriculum can be developed.

In the United States, the development of this curriculum component system with agreement on learning outcomes ideally should proceed in collaboration with the Association of American Medical Colleges (AAMC), the Liaison Committee on Medical Education, and the NBME. The goal should be to harmonize the expectations of the accrediting and licensing bodies with content and curriculum experts, school administrators, medical student leaders, and patient advocates. Representation from both public and private medical schools should be sought as well as from schools that are known for their primary care priorities, clinical excellence, social consciousness, and/or research focus.

In the absence of such an organized effort, there are multiple existing and emerging sources of free or low-cost reusable curricular content learning objects. MedEdPORTAL is an open-access journal of health professions teaching and learning resources published by the AAMC. Aquifer (formerly MedU) is a nonprofit organization that develops virtual patient learning experiences that are widely used in medical school clerkship education. The International Databases for Enhanced Assessments and Learning Consortium is an international collaboration among medical schools to maintain and disseminate a shared bank of assessment items. Several private-sector entities, including Firecracker, medskl, Osmosis, and ScholarRx (led by T.T.L.), are also scaling the development of low-cost, componentized, digital curriculum resources and services.

The Need for Standards

Identifying core curriculum content and making it digitally shareable is not enough. Shared content components often are incompatible because of differing pedagogic and content-development approaches at individual

Table 1
Possible Criteria for Defining Core Curriculum Content Components

Criteria	Example
Foundational scientific concept	Pathogenesis of disease
Foundational building block	Biochemistry
Critical to the understanding of scientific evidence	Biostatistics
Implication in understanding the burden of disease	Epidemiology
Necessary for the thoughtful approach to patients	Communication skills
Evergreen; verified by rigorous, scientifically based study	Physiology
Utilized on a regular basis in the medical literature	Medical nomenclature
Substantial, population-based health implications	Health care reform
Rapidly evolving science with substantial future implications	Genomics
Likely impactful in understanding future medical discoveries	Molecular biology

institutions. It also is unlikely that any one organization or entity can create all the curricular building blocks needed by schools. Curriculum component standards are necessary to enable curriculum development, sharing, and adoption at scale. Certain information and data standards already exist in medical education. AAMC, the MedBiquitous Consortium, and other stakeholders collaborated to develop American National Standards Institute Curriculum Inventory standards that allow medical schools to report data for benchmarking and research related to curriculum content, organization, and methods of instruction and assessment.[4] We need to explore similar approaches to make education components interconnectable, exchangeable, and extensible in current and future learning systems, repositories, and exchanges.[5] Standardization needs to anticipate and maximize the number of evidence-based pedagogic strategies that can leverage the common curriculum components. Over time, we expect that such standards will drive down development costs, foster innovation, and encourage collaboration among stakeholders, all of which is necessary for the emergence of a vibrant and robust ecosystem.

Access to a standardized, shared set of curricular resources can empower faculty and positively transform their education responsibilities. No longer burdened with "reinventing the wheel" at each medical school, faculty can focus more on strategies to optimize curriculum delivery with increased opportunities to interact with students. As a result, students will benefit from a more consistent learning experience across curriculum blocks, threads, and education sites as well as better alignment between curricula and national licensure exams.

Additional Potential Benefits

It is likely that the strategy of creating and sharing core curriculum elements could begin to bend the cost curve for medical education. There is no debate about the need to do so. In 2016, the median four-year cost of attending medical school in the United States was nearly $250,000.[6] Nearly three out of four graduates had educational debt, with a median educational debt of almost $200,000. Indeed, debt reduction is a leading factor cited by medical school deans who have implemented or are considering three-year MD pathway programs and/or time-variable, competency-based medical education programs.[7] For medical schools interested in shortening the duration of matriculation, a predominantly online experience for some of the foundational courses could reduce the time for on-site matriculation or provide flexibility for colocalization and integration of formal education with clinical training sites.

The creation and sharing of curricular learning objects also could serve a broader, global purpose. There are approximately 2,600 medical schools in the world. The World Health Organization estimates that there will be a shortage of approximately 13 million health care workers by 2035.[8] In most low-resource regions of the world, lack of medical educators and financial resources limits the number of health care providers who can be trained. A shareable curriculum, appropriately localized to a school's environment, could facilitate the scaling of health professional training. With modification to suit different types of learners, including health promoters, nurses, and ancillary professionals, digitally shared content could broaden the reach and impact of these learning resources beyond physicians. This is the basis for the Digital Medical Education International Collaborative, a program recently launched at Stanford University with the goal of creating high-quality, accessible, and customized health care learning experiences freely available to anyone, anywhere.

Conclusion

In summary, we believe that in light of the limited resources available at most medical schools, there is a pressing need to reduce needless, duplicative curricular development efforts across institutions. This could be addressed through the creation of a common set of shareable curricular components leading to standardized learning outcomes in core competencies. Faculty would be less burdened with content creation and could engage in high-value teaching activities. Students would benefit from a consistent education experience that includes alignment with national licensure exams. The cost savings that would be accrued by limiting instances of the common curriculum would be substantial, and those assets could be redirected to focusing on school-specific programs, capitalizing on the unique characteristics of each school. Finally, the global community could benefit from scalable education resources that could address the critical shortage of physicians and health care workers.

We are not proposing to create a "cookie-cutter" approach to undergraduate medical education. On the contrary, we want to neutralize the negative effects that result from redundant and multiple curricula while augmenting the unique characteristics of each medical school. It seems difficult to argue against a strategy that could ease the faculty workload, relieve student stress, reduce costs, and scale internationally. And, most important, we want to create the space for students to engage with faculty in their professional passions beyond the foundational curriculum that will prepare them for diverse careers as future guardians and leaders of health care and biomedical science.

Dedication: This article is dedicated to the loving memory of Tai Sy Le.

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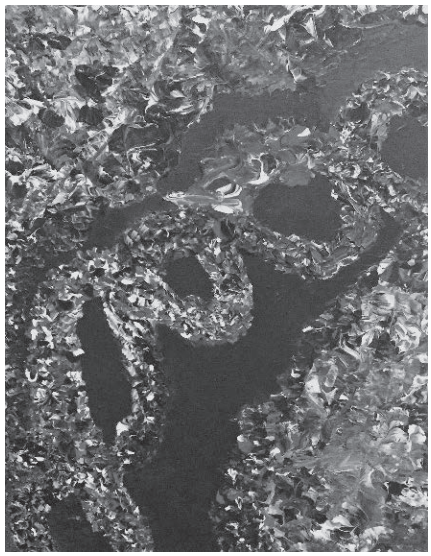
Cover Art
Artist's Statement: Precision Medicine & Data

My painting *Precision Medicine & Data*, on the cover of this issue, showcases the relationship between data and precision medicine. At the time I created this piece, I was a medical information professional at the University of Massachusetts Medical School. I found myself an active contributor in precision medicine—an emerging approach that uses data-driven research in clinical and academic settings to more accurately prevent and treat disease. For example, if three patients have the same type of cancer, they would usually receive the same treatment. However, with precision medicine, we hope for a future where each patient receives personalized medical assistance that best suits them on a genetic or molecular level. The acts of managing, analyzing, and utilizing data to improve health care on an individual level are stunning and compelling to me. My artwork represents the process of transforming data from numbers to specific applications in health care and health sciences. More simply, I want to show how data are being used to better the health of the general population.

Data are often depicted with squares, hard lines, and in linear, structured patterns. However, in the health sciences there is a beautiful mesh between the hard sciences of medicine and the human elements of patient care and well-being. My art showcases the organic, fluid, and pointedly human elements of the medical research field in a less traditional depiction of data. The amorphous clouds on each side represent some of the masses of medical data that are sorted through. These vague and near-meaningless shapes begin to form an irregular double helix that represents the trends found in data that can help individuals with their health needs. The entire painting is purposefully turbulent and semichaotic to show that the use of data in precision medicine is not a simple or clean-cut mathematical formula.



Precision Medicine & Data

I found inspiration for depicting health science data in a new way by using a classic painting technique called pointillism. Classic pointillism uses small dots of color to create images. The dots of color would traditionally be red, blue, yellow, and white. As a part of my painting technique and process, I used blue, red, white, and black to reference the constructed, abstract world of medical information. In combination with paint stippling, I also manipulated the paint and allowed it to congeal to create thick, textured layers. The organic designs show the versatility of data uses in health sciences. Data are more than machines and lines of code—my representation of the relationship between data and precision medicine alludes to the human elements that are so significant in medical research.

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