HOD ACTION: Council on Medical Education Report 5 adopted, and the remainder of the report filed.

REPORT 5 OF THE COUNCIL ON MEDICAL EDUCATION (A-19)
Accelerating Change in Medical Education Consortium Outcomes

EXECUTIVE SUMMARY

Phase one of our American Medical Association's (AMA) Accelerating Change in Medical Education (ACE) five-year initiative, launched in 2013, concluded in fall 2018. This innovative initiative, as described in Council on Medical Education Report 2-I-18,

> *[F]ostered a culture of medical education advancement, leading to the development and scaling of innovations at the undergraduate medical education level across the country. After awarding initial grants to 11 U.S. medical schools, the AMA convened these schools to form the Accelerating Change in Medical Education Consortium—an unprecedented collective that facilitated the development and communication of groundbreaking ideas and projects. The AMA awarded grants to an additional 21 schools in 2016. Today, almost one-fifth of all U.S. allopathic and osteopathic medical schools are represented in the 32-member consortium, which is delivering revolutionary educational experiences to approximately 19,000 medical students—students who one day will provide care to a potential 33 million patients annually.*

The initiative has been successful in stimulating change at member institutions and propagating innovations nationwide. Students benefitted from training in new topics (such as health systems science) and in the creation of more precise, individualized educational pathways to support broad competency development. Faculty members benefitted from evolving funded educational roles and the opportunity for scholarship and academic advancement. Member medical schools reported enhanced reputations that strengthened recruitment and positioned them for additional external funding. Health systems benefitted from faculty and students trained in quality improvement, patient safety, and systems thinking. ACE collaborations produced 168 academic publications, which to date have been cited over 1,000 times. Over 600 consultations involving 250 institutions served to accelerate innovation across the country and internationally. In short, the ACE initiative fostered a community of innovation in medical education centered around our AMA.

This informational report provides a detailed description of the activities and outcomes of the ACE initiative. Impacts on students, faculty members, member institutions, health systems, the general medical education community, patients, and the reputation of the AMA are described. Future directions to advance our AMA's role as a catalyst for medical education innovation are outlined.

HOD ACTION: Council on Medical Education Report 5 adopted, and the remainder of the report filed.

REPORT OF THE COUNCIL ON MEDICAL EDUCATION

CME Report 5-A-19

Subject: Accelerating Change in Medical Education Consortium Outcomes

Presented by: Carol Berkowitz, MD, Chair

INTRODUCTION

Launched in 2013 by the American Medical Association (AMA), the Accelerating Change in Medical Education (ACE) initiative established and continues to foster a community of innovation and discovery by supporting the development and scaling of creative undergraduate medical education (UME) models across the country. Grants initially were awarded to eleven U.S. medical schools; funding was extended in 2016 to an additional 21 U.S. schools. The AMA convened these schools to create the ACE Consortium, providing an unprecedented opportunity for cross-institutional partnerships to implement and disseminate groundbreaking ideas.[1,2] Almost one-fifth of all allopathic and osteopathic medical schools in the United States are represented by these 32 grantees. Collectively, these schools are delivering revolutionary educational experiences to approximately 19,000 medical students across the country. Extrapolating the reach of students graduating from these programs, it is estimated that they will provide care to approximately 33 million patients annually.

The initiative has been successful in stimulating change at member institutions and propagating innovations across the United States. Students benefitted from training in new topics (such as health systems science) and in the creation of more precise, individualized educational pathways to support broad competency development. Faculty members benefitted from evolving funded educational roles and the opportunity for scholarship and academic advancement. Member medical schools reported enhanced reputations that strengthened recruitment and positioned them for additional external funding. Health systems benefitted from faculty and students trained in quality improvement, patient safety, and systems thinking. ACE collaborations produced 168 academic publications, which to date have been cited over 1,000 times. Over 600 consultations involving 250 institutions served to accelerate innovation across the country and internationally. In short, the ACE initiative fostered a community of medical education innovation centered around our AMA.

This report reviews the historical context prompting the initiative; structure and processes of the project; outcomes for students, faculty members, member institutions, health systems, the general medical education community, patients, and the reputation of the AMA; and outlines future steps.

OUR AMA'S HISTORICAL EDUCATIONAL MISSION AND LEADERSHIP ROLE IN EDUCATIONAL REFORM

Since its founding in 1847, the AMA has demonstrated a commitment to developing and supporting advancements in medical education, both autonomously and in partnership with others. The AMA's influence includes the Council on Medical Education's contributions to the Flexner Report in 1910 and the formation and sponsorship of organizations such as the Liaison Committee

on Medical Education (LCME), Accreditation Council for Graduate Medical Education (ACGME), and Accreditation Council for Continuing Medical Education (ACCME).[3]

In 2005, the AMA launched a multi-year forerunner to the ACE initiative, the Initiative to Transform Medical Education (ITME), which was intended to "Promote excellence in patient care by implementing reform in the medical education and training system across the continuum, from premedical preparation and medical school admission through continuing physician professional development."[4] ITME comprised three phases: identification of existing strengths, gaps, and opportunities for improvement in physician preparation; development of recommendations for change in the system of medical education to address the gaps; and prioritization of needed changes in medical education. In 2006, Innovative Strategies for Transforming the Education of Physicians (ISTEP), a separate initiative (later encompassed by ITME), was launched to develop the evidence base needed to generate decisions leading to reform in physician education.[5-10]

To promote sustained organizational support of these important initiatives, the Council on Medical Education in 2007 recommended that the AMA "continue to recognize the need for transformation of medical education across the continuum...and the need to involve multiple stakeholders in the transformation process, while taking an appropriate leadership and coordinating role."[11]

In 2012, the AMA announced a new strategic plan, which included accelerating change in medical education as one of three key focus areas, leading to the development of the ACE initiative as it is known today.

CONTEXT OF MEDICAL SCHOOL CURRICULUM REFORM PRIOR TO THE LAUNCH OF ACE

Although medical educators have a strong tradition of continual iterative improvements in programming, these efforts have commonly been focused on enhancing individual courses or isolated programs. The turn of the 21st century, marking nearly 100 years since the Flexner Report, served as a stimulus to contemplate more transformative and large-scale change. A plethora of reports acknowledged that the delivery of health care had evolved significantly with little concomitant adjustment in the overarching medical education process. Calls for bold transformative change emerged from national professional organizations, foundations, and advocacy groups, engaging an international audience in a dynamic discussion.[12-23]

The Carnegie Foundation, for example, supported a qualitative analysis by Irby et al. of multiple institutions embarking upon educational innovations, resulting in the 2010 book *Educating Physicians: A Call for Reform of Medical School and Residency.* Four key themes emerged from this work as systemic needs:

- Standardization of outcomes yet individualization of process;
- Integration of formal learning with clinical experience;
- Fostering habits of inquiry and improvement; and
- Formation of professional identity.

The Carnegie report served as a call to action in the medical education community and acknowledged the need for significant resource investment and leadership for organizational change. At the time, however, best practices could not be offered based upon the timing and scope of the team's analysis.[19,20]

In 2010, Susan E. Skochelak, MD, MPH, then Vice President for Medical Education at the AMA, performed a comprehensive review of recommendations for change from the prior decade, with an in-depth analysis of 15 major reports from the United States and Canada (including the AMA's ITME and ISTEP initiatives). Eight major recurring themes were identified:

- Enhancing integration across the educational continuum;
- The need for evaluation and research of educational methods and processes;
- New methods of financing medical education;
- The importance of physician leadership;
- An emphasis on social accountability;
- The use of new technology in education and medical practice;
- Alignment of the educational process with changes in health care delivery; and
- Future directions in the health care workforce.

In discussing the remarkable congruence across such reports, Dr. Skochelak challenged educators to move from research to action: "We can be assured that we don't need to keep asking 'What should we do?' but rather 'How can we get there?'"[12]

Additional scholarly work from this period elaborated upon specific recommendations. The 2010 Lancet Commission report called for tighter integration of medical education systems with health care delivery systems and anchoring desired educational outcomes to evolving societal needs.[17] To meet current social needs, Berwick and Finkelstein advocated that students must be prepared to work in, and contribute to the continual improvement of, health care systems: "Physicians should not be mere participants in, much less victims of, such systems. Instead, they ought to be prepared to help lead those systems toward ever-higher-quality care for all."[21] Addressing the movement toward competency-based approaches (standardized outcomes), Hodges validated the importance and challenges of authentic workplace-based assessment of performance and the merits of individualized pathways, yet cautioned that the professional identity formation of learners not be neglected in shifting paradigms: "There could be no more 'see one, do one, teach one.' Rather the phrase would have to be updated to something like 'watch until you are ready to try, then practice in simulation until you are ready to perform with real patients, then perform repeatedly under supervision until you are ready to practice independently'."[22] Nora addressed the critical need for health systems and academic centers to invest in faculty development: "Faculty members must be given the release-time and the tools necessary for success, with the understanding that they must use these resources appropriately and meet the expectations of their roles."[23]

Despite these repeated calls for change and relatively strong agreement on key elements to be addressed, only marginal progress was made in transforming medical education. Recognizing that significant change may lie beyond the scope of individual institutions, the AMA stepped in to serve as a guiding body to build consensus, identify best practices, and provide both financial and moral support for the challenging work to be done. By committing significant financial resources to this initiative, the AMA generated a sense of urgency among medical educators and administrators.

ACE OBJECTIVES AND PROCESS

Based upon the previously outlined international medical education discourse, the following core objectives were established for ACE:

Objective 1: Developing new methods for teaching and/or assessing key competencies for medical students and fostering methods to create more flexible, individualized learning plans.

Objective 2: Promoting exemplary methods to achieve patient safety, performance improvement, and patient-centered team-based care.

Objective 3: Improving medical students' understanding of the health care system and health care financing.

Objective 4: Optimizing the learning environment.

With objective 1, the AMA endorsed competency-based medical education (CBME), which explicitly aligns curricular offerings and assessment of student performance with the desired outcomes of the educational program. Since CBME has been embraced in graduate medical education (GME), supporting its implementation in UME would promote alignment across the continuum of training. Competency-based approaches enhance attention to areas of performance beyond the traditional focus on medical knowledge and clinical skills. Because each student possesses differing strengths and educational needs, fully fostering this breadth of competency requires flexible, individualized pathways.[23]

Objectives 2 and 3 were quickly identified by the consortium's membership as closely related. Collaboration among the ACE institutions ultimately resulted in articulation of the larger construct of health systems science, identified as the "third pillar" of medical education alongside the traditional focus on basic science and clinical skills. Objectives 2 and 3 are jointly referred to as "health systems science (HSS)" in subsequent sections of this report.[24-26]

Objective 4 acknowledged our AMA's concerns regarding physician burnout. Additional drivers supporting attention to the environment in which students learn include cognitive science about the learning process; a desire to promote the success of a diversity of students; and emerging evidence of "imprinting," or persistence throughout a physician's later career, of certain dimensions of the health system(s) in which one trains (such as quality, cost, and professionalism behaviors).

The ACE program was planned to function at two levels. Grants were awarded to individual institutions to complete local projects aligned with one or more of the initiative's objectives. Additionally, the program was structured to promote organic collaboration among institutions, resulting in amplification and acceleration of the change process.

The AMA's initial request for proposals in 2013 generated an overwhelming response: 119 letters of intent were received, representing 80% of eligible U.S. medical schools. Of those letters of intent, 31 applicants were invited to submit full proposals. To assure attainment of the objectives, successful applicants were required to describe a significant commitment from the relevant associated clinical system. Of the 31 applicants, 11 institutions were selected, each funded at $1 million over a five-year period (see Appendix A, Table A-1). In addition to this funding, the AMA supported two face-to-face meetings of consortium members each year of the grant. Common themes quickly emerged and resulted in collaboration across institutions. Multiple interest groups were established, for which ACE staff provided administrative support and project management, and the AMA convened in-person thematic meetings to propel key shared initiatives. Throughout the process, national partners were engaged to facilitate innovation, including the Association of American Medical Colleges (AAMC), LCME, ACGME, National Board of Medical Examiners (NBME), American Osteopathic Association (AOA), American Association of Colleges of Osteopathic Medicine (AACOM), and the Josiah Macy Jr. Foundation. Many of the outcomes reported here were generated by such inter-organizational efforts.

In 2015, the AMA recognized the opportunity to further propagate the work undertaken by the first cohort of ACE grantees and to address gaps in existing programs. New partners were solicited under a revised request for proposals, offering more modest funding, and the opportunity was expanded to osteopathic as well as allopathic medical schools. Of 108 applications, twenty-one additional schools were funded at $75,000 over a three-year commitment. (see Appendix A, Table A-1).[1]

At the time of the writing of this report, all Phase 1 grant commitments have been successfully completed. While the consortium continues to operate under a new structure, described later, the remainder of this report focuses on the outcomes of the ACE Consortium's initial five-year phase.

OUTPUTS OF ACE

The ACE member institutions from both funding cohorts implemented significant programs at their sites. Additionally, collaborative efforts among sites served to accelerate and amplify productivity. This section provides an overview of outputs and the major activities that were undertaken in the initiative; the impacts of those changes are described in the following section.

Institutional Outputs

Site-based Projects

Each funded institution implemented site-specific projects aligned with local needs and capacity. Schools defined key objectives for their projects and submitted two progress reports per year. School-based initiatives contributed to the shared ACE objectives of fostering competency-based approaches and individualized pathways, promoting education in HSS, and improving the learning environment. The scope of the projects ranged from a targeted intervention to support a specific theme (such as training in HSS) to sweeping curricular overhauls that addressed multiple objectives. As anticipated, some sites revised their objectives over the life of the grant. Despite these recalibrations, core themes persisted. See Appendix A, Table A-1 for a brief description of each school's project and its relationship to the overarching ACE objectives.

Common Changes to Curricular Content and Structure

Each institution was queried regarding the implementation of curricular content areas of interest to the AMA. Topics that generally moved from contemplation to implementation included elements of HSS (related to objectives 2 and 3); systems thinking; leadership and change agency; clinical informatics and health information technology; value-based care; health care economics; quality improvement; patient safety; teamwork and interprofessional care; and health care policy.

A similar query was made regarding changes in structural frameworks supporting student education. Common programmatic changes supported competency-based medical education (objective 1), including flexible individualized learning plans and deliberate assessment of readiness for internship, as well as optimization of the learning environment (objective 4), including medical student coaching and medical student wellness programs.

See Appendix B, Tables B-1 and B-2 for more detailed information regarding common shifts in curricular content and structure in local institutional projects.

Collaborative Outputs

A significant benefit of convening consortium members twice per year was the sense of community that quickly developed. Institutions striving to implement bold ideas were able to share their strategies and, importantly, share their struggles and failures (an uncommon practice in traditional academic environments). This resulted in a deep, shared commitment to the difficult work of creating the medical schools of the future and spurred rapid dissemination of solutions among consortium members and the academic community.

Table 1, below, presents areas of shared efforts across consortium members. Appendix C provides a more detailed description of these topics.

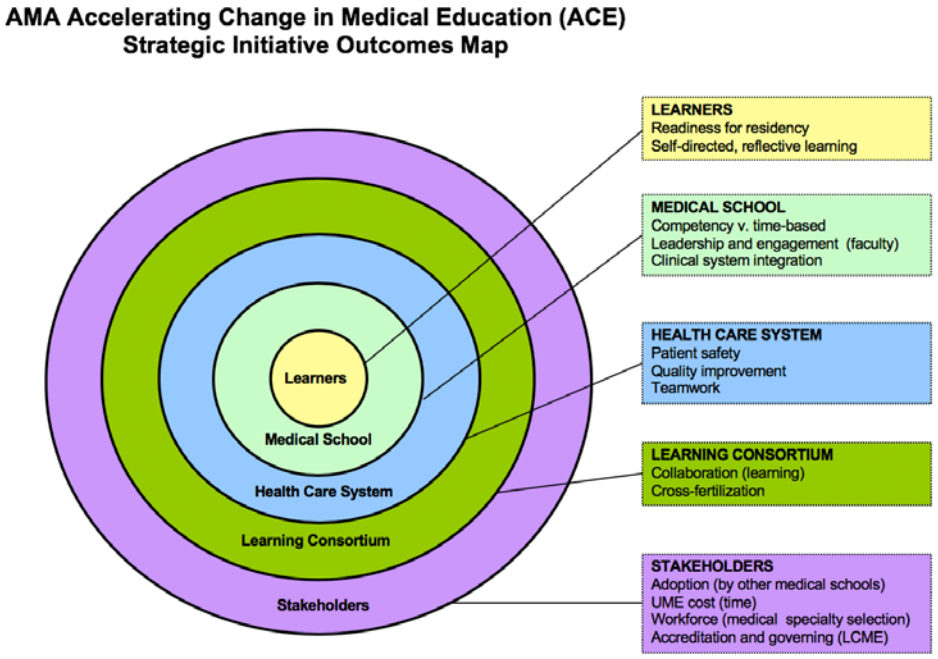
Table 1

Topic Area	Corresponding ACE Objective(s)	Shared Curricular Efforts
Competency-Based Medical Education and Individualized Pathways	Objective 1: Developing new methods for teaching and/or assessing key competencies for medical students and fostering methods to create more flexible, individualized learning plans.	Competency assessments Readiness for residency Individualized learning plans Flexible curricula
Health Systems Science	Objective 2: Promoting exemplary methods to achieve patient safety, performance improvement, and patient-centered team-based care. Objective 3: Improving medical students' understanding of the health care system and health care financing.	Value-added roles for medical students Medical students embedded in the community Patient safety and quality improvement Social determinants of health Chronic disease
Optimizing the Learning Environment	Objective 4: Optimizing the learning environment.	Well-being Master adaptive learner[28] Coaching Technology Evaluation

IMPACT OF ACE

At the formative stage of the consortium, several tiers of potential impact were envisioned, as described in Figure 1. Multiple measures tracked over the life of the initiative reflect the successful implementation of bold innovations across the 32 medical schools, and document the significant impact on member institutions, their constituents, and stakeholders beyond the consortium.

Figure 1



Impact on ACE Learners

Students at consortium schools benefited from direct interventions that included the addition of specific content (such as HSS)[24-26] as well as processes to enhance learning outcomes (such as competency-based approaches and coaching).[23,28]

Grantees reported anticipated enhanced student readiness for residency and anticipated improvements in graduates' competency in patient-centered care, communication, interprofessional collaboration, patient safety, quality improvement, value-based health care, addressing social determinants of health, telemedicine, and electronic health records. Many sites applied ACGME milestones[29] and AAMC Core Entrustable Professional Activities (EPAs)[30] to measure student progress, and the NBME HSS exam provides evidence of the acquisition of new knowledge in these areas.[31] At the time of this report, most member institutions were just starting to graduate cohorts of students affected by changes in programming. Downstream evidence to assess the actual performance of ACE graduates will include graduate surveys, program director surveys, and analyses of ACGME milestone outcomes during residency.

The consortium contributed to a culture change within institutions and the creation of processes to support more precise education. Greater attention to assessment in the workplace generated more timely, actionable feedback for students. Individualized, student-centered, and in some cases accelerated pathways provided greater alignment of learning experiences to learning needs and

opportunities for reduced time in school, reduced tuition expenses, and reduced need to repeat material for which the learner is already demonstrably competent.

Professional identity formation was enhanced by many of the grant interventions. Consortium school faculty and students reported that real-life simulations, coaches (as opposed to traditional advisers), and population-centered care frameworks taught students how to care for individual patients and collaborate across specializations to improve health care systems. As one medical student from A.T. Still University-School of Osteopathic Medicine in Arizona offered:

> *As a former student who was permitted to participate in several community health projects while in medical school, I can report on the tremendous impact it has had on my appreciation of community health. Medicine is quite sterile in academia, which is very difficult to escape - even during highly structured clinical years. However, community-based projects seem to breathe life into our profession, allowing us as students to more fully appreciate elements such as specific socioeconomic factors that keep people from pursuing care, or how HIV is experienced in rurality. As a family medicine resident, it is striking how many students seem to find their "purpose" in medicine after a community project inspired some shift in career paths altogether. The common denominator is that deeper connection to a community, which is just so hard to get with the abbreviated time we have in traditional medical school curricula.*

Students also benefitted from participation in leadership and scholarship consortium projects, participating as active partners in designing and refining curricular interventions at many institutions.[32] As seen in Appendix D, novel and disruptive educational methods, such as near-peer mentoring among students, contributed to learning and facilitated successful curricular transition. Students were exposed to various presentation and publication opportunities and, as active leads and co-leads of experience-based scholarship, developed problem-solving skills and adaptability through innovation and creativity.

Impact on ACE Medical Schools

Participating institutions experienced an overarching impact beyond the direct effect of the grant projects. In their final reports to the AMA, grantees were asked to reflect on what had been the most significant contribution of the grant at their institution. The responses were broad, ranging from improvement in specific areas of curriculum (such as interprofessional care and electronic health records) to impacts on institutional culture and prestige.

The magnitude of change that ACE projects demanded involved multiple institutional challenges, including confronting established approaches to education and skepticism about the need for change; senior decision-makers who were resistant to innovation and/or changing the educational status quo; significant in-kind resources needed to implement and sustain changes (including resources to support administrative burden, the need for feasible and motivating compensation models, and new technological platforms); policies, both state and institutional, that did not immediately permit innovation; and the need to develop mechanisms to provide effective and sufficient communication to all stakeholders.

Several schools noted that the prestige of the grant and the consortium provided credibility for their educational mission, which facilitated successful implementation of their grant project and led to changes in their institution's fundamental approach to education. Grant funding and consortium participation stimulated increased collaboration among institutional stakeholders, including students, faculty, and the affiliated health system. Additionally, the grant conferred external

validation on institutions as leaders in educational innovation. A sampling of schools' feedback on the initiative provides a glimpse into these opinions:

> *For the AMA to fund our initiatives was confirming, accelerating, consolidating, the push that we needed.*
> Vanderbilt University School of Medicine

> *The ongoing recognition and attention of the project accomplishments continues to facilitate visibility and the sense of culture change.*
> East Carolina Brody School of Medicine

> *The grant provided important validation of our vision.*
> University of California, San Francisco School of Medicine

For some schools, the AMA grant spurred additional funding. Schools received supplemental funding for their projects from universities, regional foundations, states, and health systems. Consortium schools received over $16 million in Health Resources and Services Administration grants related to ACE projects, and two schools received gifts related to medical student education totaling $700 million. In addition, ACE schools received grants from the Kern Institute, Josiah Macy Jr. Foundation, Robert Wood Johnson Foundation, Substance Abuse and Mental Health Services Administration, ACGME, and the National Institutes of Health.

Impact on ACE Faculty

ACE grants prompted significant changes in faculty roles and expertise. Grantees reported that curricular innovations resulted in the creation of new positions or the repurposing of existing positions. Across the 32 schools, 900 faculty positions were affected, and a total of 87 full-time equivalent (FTE) positions were redistributed as novel educational formats drove new faculty roles. The most common new roles included small group facilitators, coaches, and faculty trained to teach HSS and mentor student-led quality improvement projects.[33] These transformative impacts on funded faculty roles are projected to continue even now that AMA grant funds have ceased to support site-based projects.

Faculty challenges related to the change process included faculty and other health professionals' engagement; buy-in for new collaborations; time demands of design and implementation; building and maintaining a team of educators to resolve necessary changes in staffing and facilities; a lag between implementation of novel teaching or assessment methods and faculty comfort with leading them (an unavoidable gap in depth and breadth of expertise); funding for, and leadership of, sustainable faculty training and development; turnover of dedicated faculty or administrators; and providing effective and sufficient communication across all stakeholders.

Despite these challenges, grantees reported that faculty increased their own knowledge areas and expertise. New curricular content areas, such as patient safety and quality improvement, demanded faculty training, which in turn was reported to affect faculty members' own clinical practices. Changes in process also required faculty development. Competency-based methods encouraged faculty members to focus on student development rather than grades, reminding faculty of their critical role in serving the needs of future patients.[34,35] Faculty learned how to develop data-driven curricula and teaching in support of diverse patient care and reported a greater shared sense of purpose across departments and professions. Looking to the future, institutions anticipate expanded faculty knowledge and mentoring, increasing the value that students bring to patients and communities through multiple pathways (e.g., direct patient care and interprofessional teamwork).

Additional faculty impacts included enhanced opportunities for academic advancement. Schools reported that consortium activities stimulated scholarship that would not have occurred otherwise, as well as cross-institutional and cross osteopathic/allopathic collaborations. The resulting manuscripts[24,28,31,33,36-50] were more competitive for publication, improving a key metric for faculty advancement. Sites cited an increase in faculty participation in national and international presentations over the course of the grant, and reported that grant activities led to a total of 71 promotions (reported by 31 of 32 schools) and 99 appointments to named positions within their institution (reported by 29 of 32 schools). Additionally, schools shared that the national prestige associated with consortium membership allowed them to cast a wider net in recruiting top faculty and administrators to their institutions. Further examples regarding the benefits to faculty of consortium participation may be seen in Appendix E.

Impact on ACE-affiliated Health Care Systems

The most direct impact of consortium activities on affiliated health systems resulted from the deliberate incorporation of HSS training, focusing on how health care is delivered, how health care professionals work together to deliver that care, and how health systems can improve patient care and health care delivery. Some schools designed experiences for students to learn leadership, work in their community, or team up with interprofessional colleagues; others implemented rigorous quality improvement and patient safety training.[51-60] For example, the University of California San Francisco Health System and School of Medicine partnered in 2016 to embed 80 first-year medical student teams as active participants in health systems improvement efforts to address problems aligned with the health system's True North pillars of quality, safety, and value. Meanwhile, at the Pennsylvania State University School of Medicine, students were trained to serve as patient navigators who guide patients through a complex health care continuum.

To capture the impact of such student roles and student-led projects, the AMA launched the Health Systems Science Student Impact Competition in 2018. Forty-six students submitted descriptions of their work. Eligible projects addressed one of the HSS domains, such as leadership, patient safety, quality improvement, or population health. The winning entry was submitted by Kevin Tyan, a student at Harvard Medical School, who implemented strategies to protect patients and health workers from the Ebola epidemic and health care-associated infections. The second-place winner was Richard Lang, a student from Rutgers Robert Wood Johnson Medical School, a student-veteran who drew upon his military experience to improve teamwork training in medical education. The third-place submission was from Jasmyne Jackson, a student at the University of Michigan Medical School who developed a tiered mentorship program to address diversity pipeline issues, engaging pre-medical and medical students who are underrepresented in medicine to promote professional development and empowerment.

Other ACE objectives affected health systems in indirect ways. Competency-based efforts at many schools were designed to better align student training with the needs of patients and populations. The deliberate preparation of students for their responsibilities as interns was a focus at many sites, which is projected to improve the function of the health care system at the time of transition. Similarly, changes to the student learning environment impact all members of the clinical team, including residents, faculty, nurses, and other professionals.[1] Encouraging a system in which all learners work and all workers learn supports an ethos of shared learning and improvement that may mitigate emotional exhaustion and depersonalization.[61]

The ACE application process was structured to require that schools collaborate closely with their health care system, creating a shared understanding of roles, values, and learning needs of

participating students. Health system leaders were included in curricula, especially surrounding the development of HSS experiences. For example, Pennsylvania State University College of Medicine notes that:

> *Collaboration with our health system on educational initiatives over the life of the grant includes the following health systems leaders and professionals who have contributed to the design and implementation of the HSS curriculum (UME, GME, faculty development): dean and CEO of the College of Medicine and Health System, vice dean for educational affairs, chief financial officer, chief operating officer, vice president and chief quality officer, vice president of operational excellence, vice president of population health, director of ambulatory nursing, chief information officer, clinical and basic science faculty, advanced care practitioners, nurse educators, allied health professionals, social workers, librarians.*

Impact on the ACE Learning Consortium: Fostering a Community of Innovation

During the lifespan of the grant, relationships naturally spread across disciplinary lines in the consortium into a collegial, snowballing network spanning multiple topics, purposes, and depths. Although very difficult to quantify, consortium schools reported valuing this outcome tremendously and anticipated the continuation of these relationships into the future.

When asked to note the most significant contribution of the consortium, grantees repeatedly cited interaction with other educators and learning from innovations at other sites. Recurrent themes are well articulated by the following excerpts:

> *The ACE Consortium serves as a catalyst for innovation. Through conferences, online discussions, and incubator projects, it unifies a variety of experienced American medical school innovators. Through this process, members gain a shared mental model, learn best practices, discuss complex issues in learning communities, and reference a common evidence base.*
> Faculty, Brody School of Medicine at East Carolina University

> *The consortium has provided us the opportunity to share ideas, ask for help and have the status/gravitas as a consortium member to implement innovations. Our collaborations have led to deeper understandings of how to educate well and deeply and have caused us to continue to question and reform what we do. We also continue to develop ways to enact our vision of having students be value-added members of the patient care team and have seen the fruits of our past labor with our students' successful entry into their clerkships.*
> Faculty, CUNY School of Medicine

> *This consortium reinforces the truth that we are all responsible for the future of health care and that we are teammates, not competitors.*
> Faculty, A.T. Still University-School of Osteopathic Medicine in Arizona

> *The single greatest contribution of the consortium may not have been anticipated but was fully realized because of the openness that the AMA demonstrated to ensuring the 'whole was greater than the sum of our parts'. In other words, the Innovation Ecosystem that resulted from the work together in the consortium was the single greatest benefit we realized from our participation in this grant program.*
> Faculty, University of Michigan Medical School

> *In just five years, the consortium has become the home of medical education in the United States.*
> Faculty, New York University School of Medicine

Grantees also credited the following with facilitating the accomplishment of grant project objectives: endorsement by the AMA through the national consortium; internal and external networking that resulted in strong partnerships; consortium membership as a place to seed ideas, learn new approaches to similar problems, and receive professional validation; and financial support, including that from the AMA for travel and consortium meetings.

Consortium grants also led to the creation of environments supportive of student engagement with and partnership in scholarly endeavors. Student debriefings about interventions served as valuable and powerful ways to impact future faculty development. Students expressed their appreciation for being included in this community:

> *As a first-year medical student, I had the opportunity to attend the AMA consortium annual conference. It was here that I was first introduced to the community of medical educators. This community represented a shift in my medical school journey to one being centered about medical education. It was also the place where I found inspiration, learned the power of collaboration between institutions, and was encouraged to pursue my own contributions to the field. However, the most important of the community was the people I had the opportunity to meet. They will serve as role models to me as I continue my career in academic medicine.*
> Medical Student, University of Michigan Medical School

> *I was excited to see such a broad group of medical education professionals exploring ways to shake the status quo of traditional medical curricula through engagement with student perspectives and new technologies. The consortium offers an opportunity for rapid and sustainable change of long-held but flawed standards that currently prevent students from reaching their highest learning potential.*
> Medical Student, Warren Alpert Medical School of Brown University

Impact on the broader medical education landscape: scholarship and dissemination

Scholarship related to ACE educational innovations has been an important vehicle for dissemination. Over the five-year grant period, consortium members authored 168 publications, which to date have been cited by over 1,000 subsequent manuscripts. Ninety-two of these publications related to HSS, and 30 related to competency assessment. Fifty-three papers were published in *Academic Medicine*. Over 270 abstracts have been presented by consortium members in regional, national, and international venues.

The collaborative interest groups of the consortium generated significant dissemination of scholarship in non-traditional ways. The most productive interest group concentrated on defining the domains of HSS, advocating for its status as the third pillar of medical education complementing basic science and clinical skills.[24-25] This group adopted multiple modalities to promote the teaching and assessment of HSS. The resulting textbook[26] has sold over 4,000 copies internationally, and online modules are scheduled to be released in 2019. Additionally, HSS subject matter experts collaborated with the NBME to create a subject examination in HSS[31] to be administered by medical schools. In a January 2019 editorial, *Academic Medicine* Editor-in-Chief David Sklar, MD, reinforced the value of teaching HSS as the third pillar of medical education and cited HSS curricula as a potential marker of school excellence.[62] Another ACE collaborative group focused on medical student coaching created a handbook that has been downloaded more than

7,000 times from the AMA website.[27] A monograph self-published by the AMA outlining the impact of scholarship generated by consortium activities has been downloaded nearly 9,000 times.[63]

Furthering scholarly impact, grantees also served as consultants to other institutions embarking on change processes. As stated previously, the consortium served as a safe space for educators to articulate the many challenges associated with educational innovation, including negotiating accrediting requirements that do not readily allow for innovation; modernizing inflexible educational technologies; forging new collaborations across the health system; managing competing demands on student attention which may detract from the benefits of innovations; addressing students' concerns that systems thinking may lie beyond their stage of development; coping with challenges of scheduling innovative experiences within required traditional medical education cycles; building effective and sufficient communication; sustaining interventions as students from innovative undergraduate programs transition to GME; measuring educational outcomes and creating evaluation and assessment plans; and handling the complexity of linking educational interventions to patient outcomes.

The strategies that emerged from individual institutions and from consortium activities were of value to schools outside the consortium seeking to innovate. Consultations served to amplify the impact of the ACE initiative into the broader educational community, thus accelerating widespread change. Consortium members reported advising other institutions to use validated tools whenever possible; consider implementing models that already exist rather than creating new ones; increase collaborations with other departments early on in the change process; plan ahead to gather meaningful outcomes data; and ensure that there are supportive systems, processes, and administration in place before committing to such an undertaking. Over the course of the grant, collaborations of ACE schools with one another and with non-consortium institutions exceeded 600 interactions involving over 250 institutions and organizations, reflecting the sense of authority afforded to ACE members in the medical education community.

Member institutions have cooperated with accrediting agencies and governing bodies to enable innovation by removing regulatory and legal barriers. The University of California, Davis, School of Medicine worked with the state legislature of California to alter the required minimum time of training so that students committed to primary care could complete a three-year track aimed at enhancing diversity of the physician workforce. Other interventions promise a potential to reduce the costs of UME: for example, via its competency-based assessment process, Oregon Health & Science University (OHSU) School of Medicine was able to graduate 25 percent of its students a semester early, resulting in an average tuition cost reduction of $17,000. Dialogue in consortium sessions amplified national concerns about scoring for the USMLE, prompting the NBME, in collaboration with the AMA and other influential organizations, to host discussions with subject matter experts to explore this issue more deeply.

Impact on the AMA

Despite the AMA's longstanding investment in medical education, the launch of the ACE initiative represented a bold step into the UME sphere. The investment of significant resources gained initial attention, and the subsequent successful efforts of the consortium have anchored the AMA as a hub for innovation in medical education. As a consortium member school put it, "In just five years, the consortium has become the home of medical education innovation in the United States" (New York University).

In a qualitative study conducted in 2015 by consulting firm Penn Schoen Berland, 31 medical school deans who were not members of ACE were interviewed to solicit their perspectives on educational innovation and the AMA's ability to lead in that space. For several, the ACE initiative changed their view of the AMA: "It's unexpected coming from a trade organization that the AMA has been in the past. It really speaks to the present—the AMA has a different vision, which I am delighted about. I think it's very exciting."

The ACE initiative garnered significant external attention for the AMA, and it is interesting to track how earned media coverage has evolved since the ACE initiative launch in 2013. Initially, ACE coverage mainly appeared in trade publications; this is not unusual for a new initiative, as reporters often prefer to cover results and concrete milestones. ACE's visibility and reach have grown over the past five years, however, as evidenced by media coverage in national mainstream publications, including the *Wall Street Journal*,[64] National Public Radio,[65] and the *New York Times*.[66] Mentions of ACE work in more prominent, high-impact publications also have grown over time and are often synched to major announcements, such as the launch of the HSS textbook and the electronic health record (EHR) designed for educational settings. The additional uptick in the quality of journal placements was also the result of exposure to consortium meetings, relentless media team pitching, and access to press conference calls with James Madara, MD, Executive Vice President and CEO of the AMA, and Dr. Skochelak. Finally, in 2018, impressions were derived from a significant push to earn attention for the first graduating classes from consortium schools and the five-year anniversary of ACE. Increasingly, the storyline around ACE and the need for reimagining medical education have moved from health trade publications into the public consciousness. See Appendix F, Table F-1 for a listing of top *AMA Wire* articles about ACE.

To capitalize on the interest in ACE activities and expand our reach beyond consortium members, the medical education unit launched a new national conference, ChangeMedEd®, which welcomes both consortium and non-consortium members and medical education stakeholders. The inaugural 2015 conference attracted 273 participants (226 of whom were non-members); attendance rose to 363 in 2017 (including 265 non-members). Additionally, digital platforms have been exploited to create other interactions and stretch engagement to an international scale. Webinars and asynchronous discussions have been offered, with 1,000 participants across seven webinars and over 2,000 participants across 17 asynchronous discussions. More details about virtual-session topics and participation in the webinars are provided in Appendix F, Tables F-2 and F-3.

Other critical AMA initiatives have benefited from direct access to the medical educators and UME curricula affiliated with the ACE Consortium. For example, collaboration with ACE member institutions propelled efforts of the AMA's Improving Health Outcomes unit to address chronic disease by piloting a new structure of the patient history and physical to target the needs of patients with chronic illness.[49] Similarly, synergy exists between the goals of the AMA's Professional Satisfaction & Practice Sustainability unit and ACE efforts to empower students to attack the dysfunction in the health care system by training them in HSS.[61] Such empowerment is expected to enhance a sense of control and well-being, supplementing education's recent focus on individual resilience and wellness.

The myriad activities that comprise the ACE initiative have secured the AMA's position as the leading home for purposeful innovation in medical education.

Impact on patients

The ultimate goal of the ACE initiative is to improve patient care. The impacts of the ACE objectives on learners, faculty members, medical schools, health systems, and the broader medical

education community outlined in this report culminate in physicians who are better trained, more satisfied, and poised to shape the constantly evolving health care system—in short, as the AMA mission states, "to promote the art and science of medicine and the betterment of public health."

FUTURE STEPS

The ACE initiative has taken great strides toward creating the medical school of the future. Institutional members of the consortium have offered case studies in accomplishing a variety of needed reforms, and collaborative efforts across sites have identified techniques that can be generalized to other schools. Significantly, all 32 participating schools have committed to continue as members of the consortium despite the cessation of direct funds to support site-based initiatives. AMA ACE staff will continue to convert developing ideas into tangible products that can be adopted broadly. Ongoing smaller innovation grants and targeted memberships in the consortium will be offered to promote strategic areas of focus. Traditional academic venues will be complemented with alternative modes of dissemination to propagate change. To support the ultimate vision of a dynamic learning health system, the ACE unit will continue to monitor emerging trends affecting educational processes (such as artificial intelligence) and continue to partner with other agencies to incorporate new objectives into ongoing innovation efforts.

Building on its work to accelerate change in UME, the AMA recently established the Reimagining Residency initiative—a new five-year, $15 million grant program to address challenges associated with the transition from UME to GME and the maintenance of progressive development through residency and across the continuum of physician training. The goal of the initiative is to align residency training with the needs of patients, communities, and the rapidly changing health care environment. Grants are intended to promote systemic change in GME and support bold, creative innovations that provide a meaningful and safe transition from UME to GME, establish new curricular content and experiences to enhance readiness for practice, and support well-being in training. With a focus on collaboration, the initiative aims to inspire cooperation among the distinct entities responsible for oversight of GME, including medical schools, GME sponsors, and health systems. Furthermore, Reimagining Residency grant recipients will join the ACE Consortium, further expanding the AMA's community of innovation to allow for broad collaboration and dissemination of ideas across the medical educational continuum, as well as providing an independent focus on creating the residency programs of the future.

THE NEED FOR CONTINUED AMA SUPPORT OF MEDICAL EDUCATION

The ACE initiative has served to anchor the AMA as a leading force in UME innovation, and the forthcoming, unprecedented investment in GME is expected to echo and amplify that impact. Yet much work remains. Medical education is a complex process involving interaction among multiple systems with competing drivers. Systematic change requires a voice that advocates across stakeholder groups in order "promote the art and science of medicine and the betterment of public health." The success of past initiatives and the potential for future innovation speak to the need for ongoing attention to educational trends and support for innovative educational initiatives.

APPENDIX A: CONSORTIUM SCHOOLS (COHORTS 1 AND 2) AND SCHOOL PROJECTS

Table A-1
Consortium member institutions, brief descriptions of site-based projects, and alignment with ACE objectives.

School	Description of project	Competency-based	Health systems science	Learning Environment
Joined the consortium in 2013				
Brody School of Medicine at East Carolina University	Designed and created its Teachers of Quality Academy. Graduates have become a cohort of master educators on patient safety and quality improvement.		X	X
Indiana University School of Medicine	Developed a novel virtual health systems curriculum framed by the structures, policies, and evaluative mechanisms of its health system partners and grounded in a common e-patient panel accessed through the Regenstrief EHR Clinical Learning Platform.		X	X
Mayo Clinic Alix School of Medicine	Developed a four-year health systems science blended learning curriculum. Amplified efforts in student well-being.		X	X
New York University School of Medicine	Created "Health Care by the Numbers," a flexible, technology-enabled curriculum to train medical students in using big data.		X	X
Oregon Health & Science University School of Medicine	Implemented a novel, rigorous, learner-centered competency-based curriculum that allows students to pursue a broader array of interests, shifting the focus toward what students learn rather than what appears on a given exam.	X		X
Pennsylvania State University College of Medicine	Launched a curriculum combining a course in health systems science with an immersive experience as a patient navigator.		X	X
University of California, Davis, School of Medicine	Established a model three-year education track and implemented it in close collaboration with the largest health care provider in the region.			X
University of California, San Francisco, School of Medicine	Created a three-phase, fully integrated curriculum, crafted to enable students to contribute to improving health care outcomes as they learn to work within complex systems and advance science.	X	X	X

University of Michigan Medical School	Assigns students to an M-Home learning community for their four years of medical school. Students achieve competency in leadership through activities integrated with other core curricular components—all while developing change management experience in health care scholarly concentrations.	X		X
Vanderbilt University School of Medicine	Established "Curriculum 2.0," which uses flexible, competency-based pathways to create master adaptive learners trained in health systems science, able to adapt to the evolving needs of their patients and the health care system throughout their careers.	X	X	X
Warren Alpert Medical School of Brown University	Developed nine new courses that constitute the basis for a Master of Science degree in population medicine for its medical students.		X	
Joined the consortium in 2016				
A.T. Still University-School of Osteopathic Medicine in Arizona	Promotes early exposure to health care needs and social determinants by embedding medical students in urban and rural community federally-qualified health centers across the country and empowering student-led systems solutions.		X	X
Case Western Reserve University School of Medicine	Places students in interprofessional teams where they manage and assess the needs of patients at high-performing patient-centered medical homes.		X	X
CUNY School of Medicine	Created a combined a seven-year BS/MD program, preparing students to become primary care physicians in medically underserved areas.			X
Dell Medical School at the University of Texas at Austin	Designed and implemented a curriculum focused on servant and collaborative leadership along with training in health systems science and adaptive expertise.		X	X
Eastern Virginia Medical School	Teaches health systems science, along with basic and clinical sciences, through a case-based, integrated approach using a virtual community of culturally diverse families and associated electronic health records.		X	X
Emory University School of Medicine	Standardized instruction on quality improvement and patient safety across the medical education continuum, including all medical students, residents, fellows, faculty, affiliated physicians, and interprofessional colleagues.		X	X

Florida International University Herbert Wertheim College of Medicine	Created a program where students are assigned to an interprofessional team comprised of students from nursing, social work, and/or physician assistant studies. Competency-based assessments using EPAs to monitor readiness for residency.	X	X	X
Harvard Medical School	Reorganized its entire curriculum using active-learning models, creating a mastery-oriented culture as opposed to a performance-oriented culture.			X
Michigan State University College of Osteopathic Medicine	Launched its "First, Do No Harm" curriculum that incorporates patient safety concepts longitudinally across undergraduate and graduate medical education.		X	X
Morehouse School of Medicine	Increased its class size and its community-based sites, and established learning communities designed to ensure the development of strong longitudinal faculty-student and student-student interactions to facilitate the professional transition process.			X
Ohio University Heritage College of Osteopathic Medicine	Launched "Value-Based Care," an innovative, competency-based program that integrates primary care delivery and medical education.	X	X	X
Rutgers Robert Wood Johnson Medical School	Incorporates medical students and other health-profession learners into care coordination teams at an affiliated health system's accountable care organization.		X	X
Sidney Kimmel Medical College at Thomas Jefferson University	Implemented the Regenstrief EHR Clinical Learning Platform and interprofessional health care delivery team educational experiences.		X	X
University of Chicago Pritzker School of Medicine	As part of its patient safety and health care quality curriculum, created a "Room of Horrors" simulation, in which students must recognize common hazards to patient care.		X	
University of Connecticut School of Medicine	Created a curriculum that incorporates the Regenstrief EHR Clinical Learning Platform and brings teams of medical students together across all four years with dental students and other interprofessional partners to learn core skills.		X	X

University of Nebraska Medical Center College of Medicine	Moving interprofessional education beyond the traditional classroom setting and into clinical training environments where it can be applied for the benefit of patients and populations.		X	X
University of North Carolina School of Medicine	Instructs students in quality improvement techniques focused on specific common clinical problems, positioning students to complete quality improvement projects benefiting the clinics in which they train.		X	X
University of North Dakota School of Medicine and Health Sciences	Incorporates advanced simulation and telemedicine into education about providing care to those in rural or remote communities.		X	X
University of Texas Rio Grande Valley School of Medicine	Incorporates tablet computers into a curriculum that nurtures communication skills specific to working with disadvantaged populations.			X
University of Utah School of Medicine	Adapting tools proven effective at bending the cost curve of health care to create a new educational model that emphasizes cost reduction and improves undergraduate medical educational outcomes.		X	X
University of Washington School of Medicine	Implemented a new curriculum structure across its sites in Washington, Wyoming, Montana, Alaska, and Idaho, enhancing clinical training during the basic science years and basic science in the clinical years.			X

APPENDIX B: COMMON CURRICULAR CHANGES AT MEMBER INSTITUTIONS

Principal investigators at all 32 schools were asked about common curricular interventions, including content and structural elements. Respondents indicated the state of each element prior to, and at the conclusion of, the grant, with the following response options:

- Absent, no plans to implement
- Absent, but plans underway to implement
- Newly implemented
- Progressing implementation
- Mature implementation
- Abandoned implementation (only one incident was reported of abandoning a topic)

The tables provide the most common response (mode) for each topic at pre- and post-grant.

Table B-1

Curricular Element	**Most common pre-grant status**	**Most common post-grant status**
Leadership and change agency	Absent, no plans	Progressing implementation
Health care economics	Absent, no plans	Progressing implementation
Clinical informatics and health information technology	Absent, no plans	Progressing implementation
Value-based care	Absent, no plans	Progressing implementation
Systems thinking	Absent, no plans	Progressing implementation
Master adaptive learner skills	Absent, no plans	Progressing implementation
Patient safety	Newly implemented	Mature implementation
Quality improvement	Newly implemented	Progressing implementation
Teamwork/inter-professional care	Newly implemented	Progressing implementation
Health care policy	Progressing implementation	Mature implementation

Table B-2

Structural Element	**Most common pre-grant status**	**Most common post-grant status**
Med student coaching	Absent, no plans	Absent, but plans underway to implement
Flexible individualized learning plans	Absent, no plans	Progressing implementation
Competency-based education	Absent, but plans underway to implement	Progressing implementation
Assessment readiness for internship	Absent, but plans underway to implement	Progressing implementation
Optimizing the learning environment	Absent, but plans underway to implement	Progressing implementation
Medical student wellness	Newly implemented	Mature implementation

APPENDIX C: COLLABORATIVE OUTPUTS OF ACE

This appendix provides more detailed descriptions of collaborative efforts and institutional exemplars of implementation.

Health systems science

One of the earliest innovations to emerge from the work of the consortium was the articulation of the concept of health systems science (HSS) as the third pillar of medical education, complementing the traditional focus on basic sciences and clinical skills. ACE members recognized that learners must understand how health systems deliver care to patients, how patients receive and access that care, and how to improve those systems. Experts from consortium member schools collaborated to write the *Health Systems Science* textbook, published by Elsevier in December 2016 (see text users in tables 5 and 6 below). ACE members collaborated with the National Board of Medical Examiners to create a HSS subject exam and to incorporate this content into the USMLE Step exams. A student-led thematic meeting in support of the HSS construct, "Patient-Centered Care in the 21st Century-Health Systems Science Through the Medical Education Continuum," was held at Penn State College of Medicine in August 2018. A total of 87 students, residents, faculty members and staff from 27 consortium schools attended.

Table C-1
Users of the Health Systems Science textbook

Consortium member schools	
The Warren Alpert Medical School of Brown University	Required for the Primary Care-Population Medicine program
Case Western Reserve University School of Medicine	Used throughout the MD curriculum.
CUNY School of Medicine	Used in the longitudinal clinical experience
Morehouse School of Medicine	Fundamentals of Medicine (supplement)
Oregon Health & Science University	MD Program, required
Pennsylvania State University College of Medicine	Required for Science of Health Systems courses
University of California, San Francisco, School of Medicine	Clinical and Systems Applications, supplementary text
University of Nebraska Medical Center	Longitudinal Health Systems Sciences course
University of Utah	Pathway in value/health systems
University of Washington	Reference text for the Ecology of Medicine course.
Vanderbilt University	Foundations of Health Care Delivery (FHD); all four years; also used for the pediatric GME program
Vanderbilt University Medical Center	Health Policy, supplementary. (business school)
Non-consortium medical schools, other educational institutions, and other entities	
Arizona College of Osteopathic Medicine- Midwestern University	Required for a Health Systems/Health Policy Research elective
Boise State University	Used in a nursing course
California State University, Long Beach	HCA 416 Management & Info Systems

Cedars-Sinai Medical Center	GME/Epidemiology, required
Columbia University	Supplementary, Leading Quality Improvement in Healthcare
Drexel University	Frontiers IV (recommended)
Jacobs School of Medicine and Biomedical Sciences at the University at Buffalo	AOA Leadership Track, year 2 curriculum - understanding health systems
Lock Haven University	Professional Topics Seminar/PA program
MITRE Corporation	Resource for members of the health care consulting unit
Rosalind Franklin University	Patient Safety Elective Course/Supplemental reference text used in parts in various courses, M1 and M2 years.
San Antonio Uniformed Services Health Education Consortium	Supplement to the Introduction to Quality Improvement and Patient Safety
Shenandoah University/Byrd School of Business	Health business courses
St. Anthony Hospital	GME/required
TDC Labs	Resource for entrepreneurs
Uniformed Services University F. Edward Hebert School of Medicine	Medical courses
University of Kansas Medical Center	Not used in a course; used as a resource for Scholarship and Enrichment week
University of South Carolina School of Medicine, Greenville	Integrated Practice of Medicine, used as faculty resource
Western Michigan University Homer Stryker MD School of Medicine	Residency training
William Carey University	Doctoring Skills & Clinical Science (recommended textbook)
Wright State University	Upstream Medicine

Value-added roles for medical students

Incorporating pragmatic experiences regarding HSS into curricula enhances opportunities for students to add value to the health system. At Penn State College of Medicine, students spend nine months as patient navigators embedded in transitional care programs, primary care clinics, specialty-based clinics, underserved free clinics, and nursing homes. Student navigators guide patients through the complex health continuum, providing information, patient education, emotional support and coordinating community care. Student navigators use the resulting insights to assist in implementing new processes to enhance safety, efficiency, and the patient experience.

Case Western Reserve University School of Medicine modified Penn State's patient-navigator model to work with specific populations and focus more on care coordination. Rutgers Robert Wood Johnson Medical School incorporated medical students and other health-profession learners into care coordination teams at the Robert Wood Johnson Partners Accountable Care Organization (ACO). Medical students at the University of California, San Francisco are immersed in a longitudinal, interprofessional and authentic clinical microsystem and play a role in improving patient experience and health care quality while learning and applying clinical skills.

Medical students embedded in the community

Students at CUNY School of Medicine are embedded at numerous federally-qualified health centers. During the first year, students shadow physician preceptors and develop their clinical history-taking skills. They also learn about team-based care and rotate with nurses, dieticians, and social workers in order to understand how each professional contributes to patient care. Medical students are trained as health coaches and help patients implement health-related behavioral changes, such as exercise and diet changes. Students return to the same health centers during the following two years of their longitudinal clinical experience and assist with value-added tasks, such as medication reconciliation and developing and disseminating patient education tools. Students act as navigators accompanying patients through all points of their clinic visit and begin to identify the multiple points of care, the various members of a health team and their specific roles, ranging from the front desk, to nursing/triage staff, the physician, pharmacists, social workers, and nutritionists.

A.T. Still University-School of Osteopathic Medicine in Arizona has partnered with the National Association of Community Health Centers to place second through fourth-year medical students in 12 rural and urban community health centers. These longitudinal experiences provide contextual learning about the social determinants of health and other aspects of HSS as well as the basic and clinical sciences.

Florida International University Herbert Wertheim College of Medicine (FIU) built on its "Green Family Foundation Neighborhood Health Education Learning" program (NeighborhoodHELP™). During the second, third, and fourth years, students become part of teams of interprofessional students going into households to take care of underserved families. FIU was host to "Community Medical Education: From Engagement to Development," a thematic meeting attended by 47 people from 28 consortium schools.

Patient safety and quality improvement

Patient safety and quality improvement are two other key topics included within HSS, and several schools developed a sharp focus on these domains. The University of Chicago Pritzker School of Medicine incorporates active learning in patent safety and health care quality into all four years of medical school and uses novel technological tools to do so. These tools include an online microblogging learning community with trained faculty coaches, point-of-care applications on mobile devices and a "Room of Horrors" filled with some of the scariest hazards to patient care. The Room of Horrors has been replicated by at least five medical schools and was featured at a sold-out event during Chicago Ideas Week, September 2018.

Students at Vanderbilt University School of Medicine have completed over two hundred quality improvement projects. Identifying needs over the course of their clinical experience, students complete a mentored process under the guidance of quality experts to create interventions with defined outcome metrics to ensure alignment with the priorities of the health care system. Recognizing that similar improvement efforts were occurring at multiple consortium sites, the AMA sponsored a student impact challenge in 2018. Over 40 high-impact projects were submitted, and cash prizes were awarded to 3 students.

But before medical students can be taught the competencies associated with patient safety and quality improvement, medical school faculty must learn how to teach these relatively new areas of focus in medicine. Brody School of Medicine at East Carolina University designed and created its Teachers of Quality Academy (TQA). Those who have graduated from the program have become a cohort of master educators on patient safety and quality improvement and have helped advance

these subjects across the campus and health system. Emory University School of Medicine implemented a faculty development program around patient safety and quality improvement that offers multiple options for engagement. Quality improvement training and related projects can be used to meet maintenance of certification requirements. The AMA launched a Health Systems Science Faculty Academy in September 2018 with 39 participants. In the future, the Academy will be open to consortium and non-consortium schools.

Social determinants of health

Social determinants of health, one of the domains of HSS, is a focus at some consortium member schools. The University of California, Davis, School of Medicine launched a three-year education track, the Davis Accelerated Competency-based Education in Primary Care (ACE-PC) program, in close collaboration with Kaiser Permanente of Northern California, the largest health care provider in the region. Addressing social determinants of health is central to the program's mission and curriculum. UC Davis ACE-PC students are embedded into Kaiser Permanente's integrated health care delivery system and patient-centered medical home model from the first week of medical school. Davis was the host of "Health Equity & Community-based Learning: Students as Advocates," a student-led thematic, in August 2016 that was attended by over 200 medical education leaders, medical students, and students from other health professions.

Chronic disease

In recognition of the fact that medical care is increasingly focused on chronic disease rather than acute conditions, several consortium projects have focused on shifting medical education in this direction. For example, the medical students incorporated into the ACO at Rutgers Robert Wood Johnson Medical School augment care for patients with multiple chronic conditions. Chronic disease management is a core component of the ACE-PC program at Davis. The curriculum at Eastern Virginia Medical School includes a focus on care for patients with multiple chronic conditions. The Accelerating Change in Medical Education initiative has held several meetings with Improving Health Outcomes, another of the AMA's strategic focus areas, to work toward developing medical school coursework on chronic disease.

Competency-based Medical Education and Individualized Pathways

Member institutions of ACE had varying levels of engagement in implementing competency-based approaches. At some sites, changes were limited in scope to specific interventions such as establishing intern-prep courses or defining competencies in specific curricular realms such as HSS. A subset within the consortium, however, worked closely together to advance more significant implementation of CBME and individualized pathways. Interestingly, four of the ten schools invited to the AAMC's national pilot of the Core Entrustable Professional Activities for Entering Residency (Core EPAs) were ACE Consortium schools (FIU, OHSU, NYU and Vanderbilt).

Although ACE members have not yet achieved time-variable advancement to GME, several sites did create the capacity for individualized pathways informed by competency development. At Vanderbilt, students receive feedback in all competency domains starting in the first weeks of school and complete evidence-driven personalized learning plans in a structured process supported by faculty coaches. The requirements of the post-clerkship phase can be adjusted to match the competency needs of the individual, with some students requiring more clinical skill development and others focusing on foundational sciences, while students who have attained all competency expectations are permitted full flexibility to pursue personal goals. In a similar structure, OHSU utilized competency evidence and coaches to permit some students to graduate early. Although

these students were not able to immediately enter GME, they did reduce their tuition burden. Michigan uses the analogy of a tree's trunk and branches to illustrate the relationship of core competencies expected of all students to the individualized pathways that prepare students for future leadership roles.

These sites serve as important exemplars for a challenging implementation process. Their collective experience has positioned the AMA and ACE to contribute with authority to the international call for a greater focus on educational outcomes over educational process.

Optimizing the Learning Environment

The consortium has not just been focused on what medical students learn, but also how they learn. The learning environment includes several components: personal, social, organizational, and physical / virtual.[67] ACE schools have implemented changes at all these levels to promote student success.

Well-being

Concerns for student well-being was a shared priority among members of the consortium. Many of the curricular innovations implemented across ACE sites are designed to enhance the learner's experience and thus mitigate against the dehumanizing impact of traditional training. However, it was also acknowledged that adjusting to new models can be distressing to students. Mayo Clinic Alix School of Medicine has been a leader in the realm of physician and student wellness and lead an inventory across consortium schools to identify current practices. Consortium members attacked this issue from several perspectives: assessing student distress, implementing supportive programs, defining the competencies students need to effectively manage wellness throughout their careers. Importantly, the group facilitated a shift to focus beyond the individual to align with the AMA's vision that wellness is a structural issue. Training in HSS and master adaptive learning techniques will prepare students to take control of their practice environments in the future.

Master adaptive learner

Although entering medical students may consider themselves expert learners, their prior environments were structured, with learning objectives and outcomes defined by their teachers. Successful lifelong learning requires differing strategies to juggle learning alongside the competing demands of daily practice. To illustrate this point, experts from several consortium schools such as Vanderbilt University School of Medicine, University of Michigan Medical School, Oregon Health & Science University School of Medicine (OHSU) and New York University School of Medicine developed the conceptual model of the *master adaptive learner*. Physicians who are master adaptive learners adapt to the evolving needs of their patients and the health care system throughout their careers by engaging in guided self-assessment and cyclical learning plans. Several sites introduced this model to their students and implemented authentic workplace-based opportunities to practice identifying and addressing individual learning needs.

Coaching

Coaching and the use of coaches is a key factor that supports the development of master adaptive learner. Unlike an adviser or a mentor, an academic coach may or may not have expertise in the realm of the self-identified need(s) in their learner but is skilled at helping the learner accurately reflect on their performance, their needs for growth, and gain insight into desired outcomes. Coaches help learners improve their own self-monitoring. In order to disseminate the coaching concept, the consortium published Coaching in Medical Education, A faculty handbook on the AMA website and made it freely available (log-in required). A total of 7,457 components of this

book were downloaded from the website. More than a thousand copies were mailed to medical schools for distribution. A thematic meeting focused on coaching was offered in October 2018 and attended by 81 people from 30 consortium schools.

Technology

Very little of the innovations described throughout this report could happen without the best technology infrastructure. Many of the ACE schools implemented new learning management systems to better support interactive and team-based learning. Digital platforms are critical to assemble and display the performance evidence that supports competency-based approaches to medical education. For example, at Vanderbilt, a rich informatics and technology infrastructure collects learner experiences and assessments in the learning portfolio and aggregates and displays performance data in a way that facilitates interpretation and decision-making for personalized learning plans. At OHSU, competency milestones achieved by medical students are tracked in a web-based personal portfolio, and students receive badges for their achievements. Learners can monitor their progress toward preparing for the expectations of internship in real time and can track relative progress across various domains of competency.

Training students to effectively use technology in practice is also critical. Indiana University School of Medicine (IUSM), in conjunction with the Regenstrief Institute, developed the Regenstrief EHR Clinical Learning Platform. This EHR, designed specifically for teaching, is a clone of an actual clinical EHR, using de-identified and misidentified real data on more than 10,000 patients. This platform allows medical students, starting in week one of medical school, to write notes and orders, view data on patients, and access just-in-time information links. It provides a safe and realistic health system environment from which to learn and practice clinical decision-making skills and is a resource to address learning gaps and assist students in meeting competency-based expectations. Students work within a virtual health system and use the Regenstrief EHR to identify errors and patient safety issues; initiate quality improvement and measure the success of these efforts; explore the potential for personalized medicine; and gain comfort in comparing their own practice patterns with those of their peers. Students “care” for a panel of e-patients and, blinded to the real care provided, have the ability to compare their diagnosis and treatment recommendations to those of their health student colleagues and to the actual attending provider, as well as experience firsthand the utility, power, versatility, and challenges of using health information technology to deliver cost-effective, quality health care.

The Regenstrief EHR Clinical Learning Platform was adopted by consortium and non-consortium schools, including several who built up and expanded upon this tool. The University of Connecticut School of Medicine, a consortium member, incorporated the Regenstrief EHR Clinical Learning Platform into its new “MDelta” curriculum and expanded the IUSM registry of real de-identified and misidentified patients with its collection of virtual patients and families. Sidney Kimmel Medical College at Thomas Jefferson University integrated the Regenstrief EHR Clinical Learning Platform into an interprofessional health care delivery team educational experience that all Jefferson College of Medicine, College of Nursing, College of Pharmacy, and College of Health Professions students participate in during their first two years.

New York University School of Medicine created “Health Care by the Numbers,” a flexible, technology-enabled curriculum to train medical students in using big data—extremely large and complex data sets—to improve care coordination, health care quality and the health of populations. This three-year blended curriculum is founded on patient panel databases derived from de-identified data gathered from NYU Langone’s outpatient physician practices and government-provided open data from the 2.5 million patients admitted each year to New York State hospitals. A

total of over five million de-identified patient level records are available for student projects. Students can explore every inpatient admission by DRG code, providers, charges, or hospitals. The data set is continually expanded and refined. The technology infrastructure for the NYU Health Care by the Numbers curriculum is open to the public at: http://ace.iime.cloud.

Evaluation

Evaluation has been a pivotal piece of the AMA's Accelerating Change in Medical Education initiative since its inception. The objectives of the overall initiative and the work at each site are founded upon current educational theory. Significant resources have been invested in the interventions that have been implemented, and consortium members acknowledge the duty to critically appraise outcomes. In addition to the internal evaluation plans at each site, experts from the member institutions collaborated to determine measures of success for the collective. The group has committed to advancing educational scholarship. The following section elaborates on these outcomes.

APPENDIX D: IMPACT ON LEARNERS

Case Western Reserve University Medical School

Twenty medical student navigators were partnered with refugee families at Neighborhood Family Practice, a federally qualified community health center on Cleveland's west side, during the current grant year. These students all forged relationships with their families over the course of the year, however 4 pairs of students have served as inspirations to all of us, demonstrating how care should be provided for all patients. They partnered with families who escaped war in Syria, Afghanistan, and Ethiopia. Each of these 3 medical student navigator pairs partnered with a newly arrived refugee family facing serious health issues in addition to transitioning to a new country, culture, and language. They embraced the notion of creating authentic trusting relationships by employing cultural humility and gaining the trust of their partner families. These students approached each family with kindness and attentiveness to their most pressing needs in order to eventually address health needs and promoted well-being. Additionally, they seamlessly integrated themselves into the primary care team, becoming trusted among colleagues and even consistently documenting in the electronic medical record.

Two medical student navigators partnered with a mother and adult daughter from Afghanistan who experienced serious trauma as a result of war. While the mother had been dismissed by some physicians as having "somatic complaints," the navigators attended specialty and primary care appointments to articulate all of her concerns in the context of her past trauma, living situation, and profound social determinants of health. The students facilitated treatment for a bedbug infestation in their home, new health insurance when she and her daughter were dis-enrolled, and coordinated with the pharmacy when multiple medication were not filled due to insurance and communication errors. They also helped the family obtain clothes and food when those basic resources were scarce and advocated for transition to a new case manager and trauma therapist when they determined her case had been sub-optimally handled by one agency. They ultimately assisted in making the diagnosis of rheumatoid arthritis leading to more effective systemic treatment options rather than continued dismissal as trauma related somatic complaints. They accomplished all of this while using an interpreter to communicate in Dari. This family has repeatedly shared their gratitude for the role the navigators have played in this difficult transition to the U.S.

University of North Dakota School of Medicine and Health Sciences

From a student in the program:

I felt nervous but excited to attend the simulation. I did not know what to expect. When I walked into the room, the role play began immediately. I was thinking there would have been a brief discussion of roles, but it started right away, which turned out to work out. I introduced myself to the granddaughter, and the patient in the nursing home. During the first two role plays, I felt like I did really well about talking directly with Sandra, the patient in the nursing facility, and then also talking to the granddaughter and explaining resources. I felt like that was good to do to get a better understanding of the client's cognitive level of functioning, and awareness, but also to maintain her dignity and respect by talking to her. During the second session role play, I felt like I didn't do as good of a job interacting specifically with the patient, but was more focused on the granddaughter, and learning her coping skills, supports, and informing her of services and supports.

One thing I did initially think about was that as a social worker, I typically have several resources available to give out. I was pretending to give the granddaughter brochures to review during the role play. I know I learn better from both hearing about things, but also being able to look at things, and reflect on it, and let it sit, rather than make a decision in a minute. I think in real life, without providing too much as to overwhelm the person, social workers would have resources available for the person to review. I thought about if it would be helpful to have a sample DNR to have at the simulation to review, and to tell the family, there are different types available, but that these are some of the typical questions and things to consider.

I think I need to get better with physical touch. I am really mindful about use of self and touch, and some people don't like it, while others really do, and I think in a hospital setting, depending on the situation, touch may be important. Touch, I can see, would be challenging when using telemedicine/teleconferencing in this setting. This simulation made me thing about doing telecounseling, and what that may look like, and how there could be ways to create connections depending on the population. For example, when working with youth, after rapport is established, to do a soft fist bump or something to the screen at the same time, in lieu of a handshake, or other techniques to help make a "physical connection."

Lastly, one thing I didn't say during the role play, but thought of after when talking with a classmate was that I regret not mentioning or bringing up if there was any cultural, religious, or spiritual practices that they wanted us to be aware of. I think that is really important to be cognizant of. Along those same lines, I also think it is important to be aware of how individuals learn. I know that is one thing the nurses locally have been asking is how people prefer to learn new things/learn to take their medications/learn how to do their own treatment, whether it is reading written information, watching demonstrations, or hearing/being told how to do something. I think this is important to ask so we know we are getting the client and family the information in inclusive ways.

I really enjoyed the simulation, and I would be open to participating in others. I liked how there was one session without the OT and then how the next one the OT was there. It gave me and the team good insight about what their role was. I wonder how it would be if there was one simulation without a social worker, and then the next one with a social worker, and how the team would see the difference. This role play did peak my interest in hospital social work and prompted me to do more learning on advanced directories and living wills for myself, and also for people I may work with.

APPENDIX E: IMPACT ON FACULTY

Researchers at the Brody School of Medicine at East Carolina University created the Redesigning Education to Accelerate Change in Healthcare (REACH) program, comprised of three separate but interconnected parts: 1) Teachers of Quality Academy (TQA); Leaders in Innovative Care (LNC); Longitudinal Core Curriculum (LCC). The TQA is a faculty development program that has been designed to increase the pedagogical and leadership capacity of faculty in HSS, specifically within the areas of quality improvement, patient safety, population health, and interprofessional education. Focusing upon both content and process across the medical education continuum, the TQA aims to achieve excellence in health care delivery through dedicated training and application of team-based, patient-centered care.

To date, there have been 78 graduates from the Academy, 18 of whom have received promotions. There have been opportunities for interinstitutional collaboration – for example, between Brody, Penn State, and Case Western – resulting in a draft health systems science assessment tool and refinement of a health systems science longitudinal curriculum. An annual quality improvement and medical education symposia series have been established as well as seminars, cross campus collaborations, opportunities for mentoring, and clinical experiential applications. TQA graduates shared their personal philosophies which include:

> *I want to be known for being an approachable, optimistic, trustworthy leader so that I can deliver innovative, productive, and compassionate care.*
>
> *I want to be known for being respectfully decisive and sincerely optimistic so that I can deliver meaningful results based on competent analysis.*
>
> One graduate summarized the experience in the following way:
>
> *TQA was one of the most comprehensive learning experiences I've participated in. Learned much more than I expected. Collaboration with others in the group was a great benefit learned. Thank you to the leaders and course coordinators.*

APPENDIX F: IMPACT ON THE AMA

Table F-1

Top 10 AMA Wire titles	Pageviews
Not your grandfather's med school: Changes trending in med ed	8,610
3 big ethical issues medical school doesn't prepare you for	6,279
New textbook is first to teach "third pillar" of medical education	6,023
Video games are changing medical education	5,683
Why medical schools are building 3-year programs	5,647
Pre-residency boot camps prep med school grads for new realities	4,420
Tailor-made plans help M4s get more out of last year before GME	4,221
At these 3 med schools, health systems science is core component	4,040
New approach equips med school grads for tomorrow's health system	4,016
Advice for a med student's must-have—a sound night's sleep	3,920
Total page views from 10/26/16 to 9/28/18	**193,992**

Table F-2

2017 Webinars	Date (2018)	Participants
Inter-Professional Education	Jan 29	250
Student Wellness	March 19	296
Student Leadership	May 21	171
Student Portfolios	July 30	178
Health Systems Science in MedEd (US/South Africa)	Aug 13	77
Value-Added Roles for students	Sept 17	89
Leadership in HSS (US/South Africa)	Nov 1	46
		Total Participants: 1107

2018 Webinars	Date (2018)	Participants
Regenstrief Teaching Virtual EHR	4/24/2017	204
Educause Collaboration	6/5/2017	N/A
Big Data for Population Health	8/21/17	199
Health Systems Science	10/23/17	186
Inter-Professional Education	1/29/18	250
Student Wellness	3/19/18	296
Student Leadership	5/21/18	171
Student Portfolios	7/30/18	178
Health Systems Science in MedEd (US/South Africa)	8/13/18	77
Value-Added Roles for students	9/17/18	89
Leadership in HSS (US/South Africa)	11/1/18	46
		Total Participants: 1696

Table F-3

Virtual Discussion	Date	Participants
Teaching Virtual EHR	4/24/17	51
Transforming education: Leading innovations in health professions education	5/29/17	74
Interprofessional Education: Challenges and Solutions	7/13/17	76
Reflections on the ACE Student Leadership Meeting	8/3/17	24
Using Big Data to Teach Population Health	8/17/17	36
ChangeMedEd® 2017 Discussion Forum	9/13/17	62
Health Systems Science – The Third Pillar of Medical Education	10/17/17	91
Implementing a Successful Academic Coaching Program for your Learners	12/4/17	135
Sexual Harassment of Learners in the Clinical Environment	1/16/18	111
Interprofessional Education: Using technology to teach team-based care	1/29/18	130
Medical Student Wellness and Beyond: Creating a Healthy Culture for All	3/19/18	264
Recruiting for Diversity: Recognizing Visible and Invisible Strengths	4/23/18	133
Developing the Next Generation of Physician Leaders	5/21/18	139
Enhancing Medical Student Experiences in Light of the New CMS Policy for EHR Documentation	6/11/18	213
Portfolios and Dashboards: Leveraging Data for Student Success	7/30/18	194
How Can Medical Students Add Value to Patient Care in the Health System?	9/17/18	115
MedEd Makeover: Making Room in a Crowded Curriculum	10/22/18	170
		Total Participants: 2018

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