



CONFERENCE RECOMMENDATIONS

April 9 – 12, 2015 | Arlington, Virginia

Enhancing Health Professions Education through Technology: Building a Continuously Learning Health System

The opportunities to remake America's health professions education and healthcare delivery systems are boundless. We are limited only by our willingness to change and our capacity to innovate. It is an exciting time, with necessary and important shifts well underway. We are reorienting health professions education and clinical practice toward increased access and value, better care, and improved health outcomes for all. And technology, evolving at a seemingly faster and faster pace, is a significant factor in those changes. Harnessing its power will enable advances in both education and care delivery that will improve the efficiency and effectiveness of teaching, learning, and patient care.

A fundamental next step is to bring together all these transformative efforts. By thoughtfully and creatively integrating and enhancing health professions education and clinical practice, facilitated by appropriate technology, we

can maximize the health of the people and communities we serve. Advancing this urgently needed integration was the focus of a Macy Foundation conference, *Enhancing Health Professions Education through Technology*, which was held April 9–12, 2015, in Arlington, Virginia.

“We’re seeing innovations in health professions education, in healthcare delivery, and in technology all around us,” said Macy Foundation President George Thibault. “Things are moving and changing very quickly, and we have a tremendous opportunity right now to bring these forces together to achieve optimum health for all.”

The Story Behind this Conference

In 2013, participants at a previous Macy Foundation conference, *Transforming Patient Care: Aligning Interprofessional Education and Clinical Practice Redesign*, recommended linking

interprofessional education and clinical care redesign to ensure a health professions workforce that is prepared to fulfill its societal contract to meet the health needs of the public. Many of the recommendations from that conference are being acted upon, but real and lasting change takes time. Macy hosted another conference in 2014—*Partnering with Patients, Families, and Communities: An Urgent Imperative for Health Care*—whose conferees proposed recommendations to help achieve the goal of equal participation of patients, families, and communities in linking interprofessional education and healthcare organizations.

To continue supporting progress toward systems integration, this year's Macy Foundation conference invited a diverse group of experts to explore the role of technology in enhancing health professions education and, in doing so, contributing to the linking of the two systems and the transformation of health care overall. The 38 conference participants—including representatives from health professions education, higher education, healthcare delivery, patient advocacy, and technology development—gathered over two and a half days. They were charged with making recommendations around the use of existing and emerging technologies to enhance health professionals' teaching, learning, and performance assessment across the learning continuum—from entry into their chosen fields, through graduate education, continuing professional development, and maintenance of lifelong competency. (See Table 1 for examples of educational technologies used in health professions education.)

Why is Macy looking to technology for new thinking, new tools, and new solutions? The use of technology to make processes and products more effective and efficient is not new. Nor is its use in education new. What is new is the wide reach and accessibility of technology and learning-objects for the education of all—from experienced professionals and teachers

to health professions students to patients, families, and communities—and the ability to use technology to facilitate interactions among all of them. Also new is the level at which we now incorporate diverse technologies into our daily lives. From tablets to smart phones and watches and from physical activity trackers to 3D printers, recent innovations are changing the ways we acquire information and even the ways we think. In spite of this rapidly changing landscape, educators, caregivers, and the public at large have not achieved a deep understanding of all the ways to successfully harness these technologies for the public good. There is a tremendous opportunity to leverage already available resources to improve health professions education, clinical practice, and health outcomes.

Conference Preparation

Participants prepared for the conference by reading three commissioned papers¹ that sparked engaging and provocative discussions.

The first paper, *Swirl: Trajectories for Digital Technology in Higher Education* by Malcolm Brown of EDUCAUSE, traces the dramatic changes that technology is spurring in higher education. Brown comments on the speed and breadth of transitions taking place in higher education and reflects on the ways in which technology enables the individualization (or as Brown calls it, personalization) of learning pathways, giving educators the ability to adapt learning activities to meet the unique needs of learners. Brown also considers how to capitalize on the ability to collect and analyze enormous amounts and new kinds of data about teaching and learning outcomes to continuously refine and improve learning activities. Finally, he proposes the concept of “swirl” to describe the ways in which students are disaggregating traditional, linear educational pathways and reaggregating them in new ways that cross old

¹ These papers will be included in a comprehensive conference monograph, which the Macy Foundation will publish in fall 2015.

boundaries of curricula, time, place, discipline or field, and institution.

The second paper, *Educational Technologies in Health Professions Education: Current State and Future Directions* by David Cook of Mayo Clinic College of Medicine and Marc Triola of New York University School of Medicine, describes the state of the art in technology that is already enhancing teaching, learning, and assessment within health professions education. The paper defines educational technologies as “materials and devices created or adapted to solve practical problems related to training, learner assessment, or education administration.” The authors focus on more recent computer-based technologies, which possess “some potentially transformative benefits that other educational approaches lack,” including flexibility, control, and analytics. Flexibility refers to the ability to “overcome barriers of time, distance, pace, scale, and patient safety.” Control refers to the ability of instructors “to enhance learning by standardizing course quality and content.” And analytics refers to the bigger, richer, and more objective datasets that can be generated, including details on where and when learning happens, learners’ characteristics, and learners’ performance over time.

The third paper, *The Future of Health Professions Education* by Catherine Lucey, Sandrijn van Schaik, and David Vlahov of the University of California, San Francisco Schools of Medicine and Nursing, envisions a potential future state of technology-enhanced health professions education. The authors suggest that health professions education in the future will be redesigned “as a complex, adaptive system, explicitly engineered to address the healthcare and health sciences needs of the nation.” The paper sets out six qualities that would serve as the pillars to support this vision of high-quality health professions education: 1) patient and population responsive, 2) equitable,

3) effective, 4) efficient and flexible, 5) driven and enhanced by technology, and 6) continuous and lifelong.

Conference Themes

Several key themes emerged during the conference, including recurring discussions of the critical role of faculty—broadly defined as all who are involved in teaching—in identifying, evaluating, and adapting technologies for education. Technology does not replace faculty, but can and should expand their reach, impact, and efficiency. For this to happen, faculty must be given appropriate assistance and training in developing, using, and integrating technologies, such as how to utilize online modules and assessment systems to improve teaching and learning or how to create simulation scenarios that have clinical impact. Faculty also require professional development and support to serve in new roles as mentors, coaches, and co-learners—all of which they can and must assume in a technology-enhanced education system.

Another major theme was the importance of technology as a teaching and learning tool rather than as an end unto itself. Technology can enhance the fundamentals of effective pedagogy and cognitive science. Technology also has great potential to support other broader shifts in health professions education. It enables collaboration and teamwork between and among faculty and students from different health professions and sites and it facilitates partnerships with patients, families, and communities to improve care and health outcomes. The challenges will be to identify the desired outcomes of this new pedagogy and to determine when technology—and which technology—helps achieve progress toward those outcomes.

Closely related to the theme of technology as a tool was the recognition that robust data collection, analysis, and interpretation

will facilitate the ability to individualize the educational experience. New and emerging technologies—including simulated patients, tools for online assessment and individualized practice of skills, and integrated clinical and educational outcome databases—create opportunities to gather an unprecedented amount of useful information on the educational experiences and performance of learners. These data can be used to design and refine curricula and track learner progress. These new technologies also allow students and professionals to self-regulate their learning and practice activities throughout their educational and professional careers.

The conferees agreed that technology can never—and should never—fully replace face-to-face teacher-learner interaction or personal contact with patients and families. At several points, the conversation touched on the concept of technology as a tool to preserve, accentuate, and augment humanity

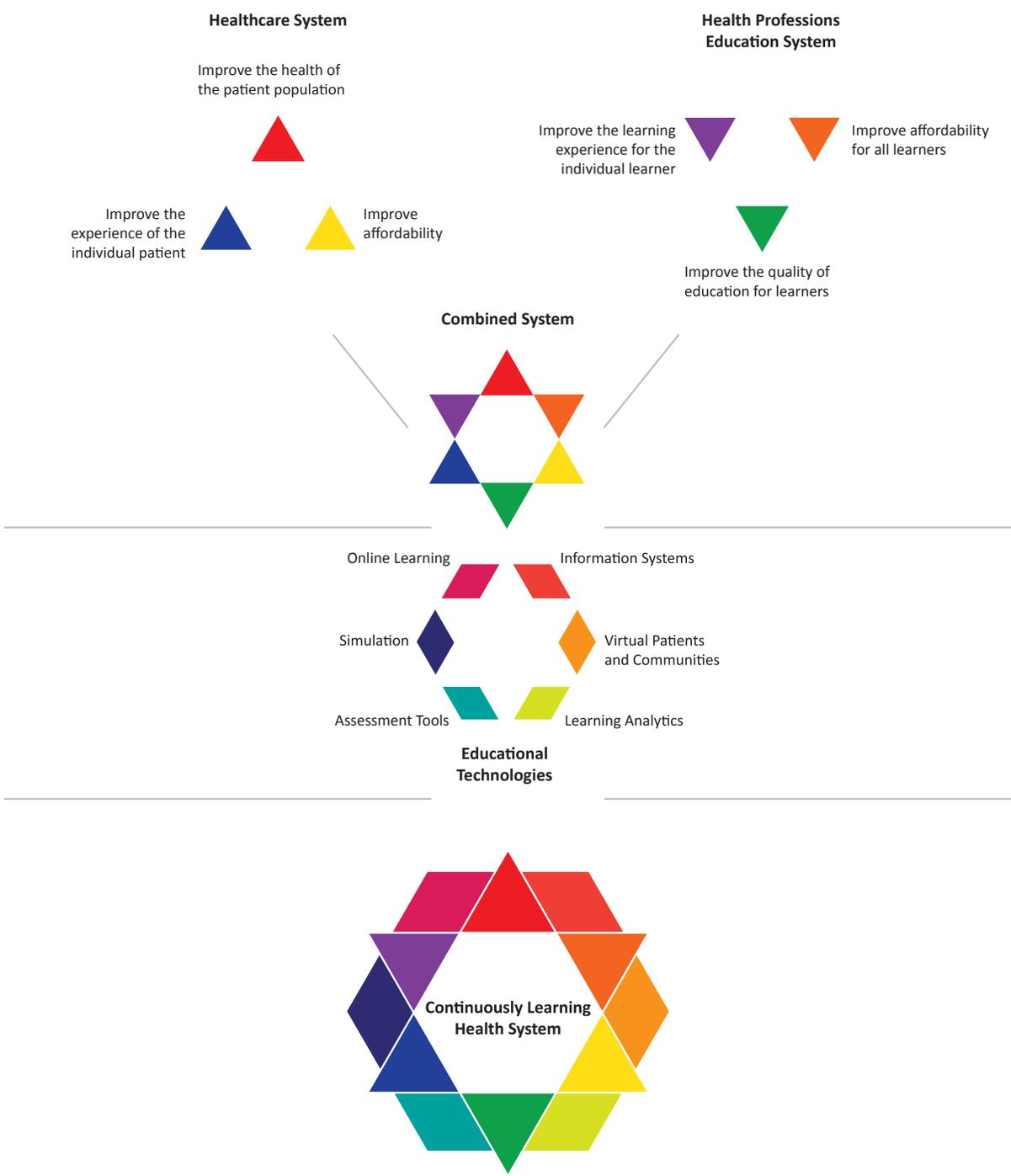
in education and health care. As the demands on health professions learners and practitioners change and expand, technology—appropriately used—can increase efficiency, thereby preserving time for learners and practitioners to connect, share, and empathize with each other and with patients, families, and communities.

Over two and a half days, conference discussions shifted from the ways technology can enhance the individual experiences of both teachers and learners within health professions education to the ways technology—specifically information technologies, data, and analytics—can improve health professions education and healthcare delivery on the whole, by helping us integrate and align the two. This broader discussion led conferees to consensus around adopting the concept of a technologically enhanced and fully integrated health professions education and care delivery system, known as a “Continuously Learning Health System.”

Consensus Vision Statement

In our vision for the future of health professions education, intelligent use of educational and information technologies supports the linkage between education and delivery systems to create a Continuously Learning Health System. In this system, teachers, learners, and clinical data inform continuous improvement processes, enable lifelong learning, and promote innovation to improve the health of the public.

Vision for a Continuously Learning Health System



This vision led to six actionable recommendations to support the activities of a continuously learning health system. The conferees felt strongly that the following actions are possible and that we are at a unique time of readiness to implement these recommendations. It is imperative that we seize this opportunity in the interest of all health professions learners and, ultimately, the health of the public.

CONFERENCE RECOMMENDATIONS²

I: *In health professions education, technology should be used to support the ongoing development of learners from undergraduate levels through clinical practice; enhance interprofessional learning opportunities; and empower every student, faculty member, and clinician to embrace the role of both teacher and lifelong learner.*

II: *Faculty in health professions education should be supported to develop skills and expertise in the selection and effective use of educational technologies to complement the teaching-learning process and assessment of outcomes.*

III: *Educational technologies should be used to accelerate the transformation of health professions education to a system that is competency-driven, affordable, and accessible to each learner.*

IV: *Technology should be leveraged to bridge the gap between educational and clinical missions, where teaching and learning are embedded within a healthcare delivery system that continuously improves.*

V: *Leaders of health professions education programs should employ technology to analyze community and population data and use those data to continuously inform the design of curriculum content and learning experiences to reflect the contemporary health and healthcare needs of society.*

VI: *Educational technologies should be used to facilitate the sharing of content and integration of data across systems and programs, thus promoting the scalability and adoption of efficient and effective educational strategies.*

² The conclusions and recommendations from a Macy conference represent a consensus of the group and do not imply unanimity on every point. All conference members participated in the process, reviewed the final product, and provided input before publication. Participants are invited for their individual perspectives and broad experience and not to represent the views of any organization. The Josiah Macy Jr. Foundation is dedicated to improving the health of the public by advancing the education and training of health professionals.

Recommendation I

In health professions education, technology should be used to support the ongoing development of learners from undergraduate levels through clinical practice; enhance interprofessional learning opportunities; and empower every student, faculty member, and clinician to embrace the role of both teacher and lifelong learner.

- Educational technologies should be used to maximize opportunities for lifelong learning “anytime, anywhere” for students, graduate trainees, faculty members, patients, and clinicians.
- Educational technologies should be used to facilitate individualized learning, personalized progression toward mastery, and active collaboration among teachers and learners.
- Educational technologies should be designed and implemented with special consideration given to enhancing the efficiency and effectiveness of teaching and learning across educational and healthcare delivery settings.
- Educational technologies should be developed to expand interprofessional learning opportunities that are not bound by time or place and that allow individuals to refresh knowledge and skills through just-in-time learning and training.

Examples³

- Several health professions education schools and even learners are developing mobile applications (apps) to support individualized learning “anytime, anywhere.” Examples: University of California, San Francisco NeuroExam Tutor (meded.ucsf.edu/tel/neuroexam-tutor-iOS-app); and Osmosis web- and mobile-learning platform, developed by Johns Hopkins medical students and used by more than 20,000 medical students (www.osmosis.org).
- With funding from Robert Wood Johnson Foundation, Khan Academy—a free online educational resource that provides self-paced, mastery-based education—is building a medical education platform to help students prepare for healthcare professions (www.rwjf.org/en/how-we-work/grants/grantees/khan-academy.html).
- Vanderbilt’s VSTAR learning portfolio system is designed to support learners’ individualized learning plans and to aggregate outcomes to guide improvement of institutions’ education programs (<https://vstar.mc.vanderbilt.edu/>).
- Smart Sparrow uses a software platform that enables faculty and clinical educators to create their own adaptive lessons that match students’ knowledge levels (www.smartsparrow.com).
- NextGenU.org provides free, for-credit online learning resources across the spectrum of health professions education. Courses are competency-based and include peer and mentored training in 128 countries (www.nextgenu.org).

³ The examples here and on subsequent pages were provided by the conferees for illustrative purposes only. We have not included all possible examples, nor does inclusion connote endorsement by the Macy Foundation or the conferees.

Recommendation II

Faculty in health professions education should be supported to develop skills and expertise in the selection and effective use of educational technologies to complement the teaching-learning process and assessment of outcomes.

- All healthcare education and delivery institutions should commit to developing and training educators in the fundamentals of learning theory and the best uses of educational technologies.
- Leaders of health professions education should create programs to support teachers in developing the skills needed to use educational technologies in their roles as curriculum designers, content organizers, coaches, facilitators, mentors, and assessors.
- Health professions education administrators should identify and implement strategies—including through promotion and tenure criteria—to engage, inspire, and reward faculty for scholarly and curricular innovations using new and emerging educational technologies.
- Health professions education programs should identify ways to best blend educational technologies and in-person learning engagement to help faculty teach in more efficient and effective ways.
- Health professions education programs should implement technology tools that support faculty in the activities of educational planning, advising and mentoring, tracking student progress, and the early identification of, and intervention with, students in need of special academic guidance and support.
- Leaders in health professions education should establish an interprofessional

- repository of best practices in the uses of educational technology as well as mechanisms for their distribution and ongoing development.

Examples

- Medical University of South Carolina College of Nursing has a dedicated faculty development program to teach faculty the most effective use of simulation technologies for nursing learners.
- Hundreds of health professions educators are certified through the Society for Simulation in Healthcare, signifying their competence in using simulation educational technologies (www.ssih.org).
- Several schools, such as University of California, Irvine's Institute for Online Learning, have created faculty development programs in best practices around use of new educational technologies.
- Stanford Medicine Interactive Learning Initiative is a centralized resource for Stanford's medical educators to receive consultation and other services as they consider developing online resources and new in-class sessions for interactive learning programs (<http://med.stanford.edu/smili/>).
- The Center for Medical Simulation in Boston offers week-long programs for developing healthcare educators' teaching skills for using simulation with an emphasis on debriefing (www.harvardmedsim.org).

Recommendation III

Educational technologies should be used to accelerate the transformation of health professions education to a system that is competency-driven, affordable, and accessible to each learner.

- Educational technologies should be used to assess learner readiness to participate in the care of patients and communities, document formative and summative assessments based on actual performance, and track clinical outcomes of health professionals' practices across their careers.
- Education programs should develop systems to measure and aggregate data assessing the performance of individuals, cohorts, curricula, and institutions over time, and use this information to individualize learner pathways and facilitate program improvements.
- Educational technologies should be leveraged to enable innovation and greater efficiency in fulfilling health professions accreditation standards and licensure, certification, and regulatory requirements.

Examples

- University of California, San Francisco extended its learning management system with a custom curriculum-mapping tool for health professions education competencies, entitled Ilios (www.iliosproject.org).
- Arizona State University uses an electronic dashboard to monitor the progress of all students (not health professions specific); those falling behind are provided personalized counseling (students.asu.edu/academic-success).
- The Education in Pediatrics Across the Continuum (EPAC) project is testing the feasibility of medical education and training based on the demonstration of defined outcomes rather than on time, from early in medical school through completion of residency (www.aamc.org/initiatives/epac/).
- edX is a non-profit program created by Harvard and MIT to host online courses,

including those relevant to medical education, from some of the world's best universities (www.edx.org).

Recommendation IV

Technology should be leveraged to bridge the gap between educational and clinical missions, where teaching and learning are embedded within a healthcare delivery system that continuously improves.

- Clinical and educational technologies, and local clinical policies, should be designed to permit the use of authentic clinical data, extracted from electronic health records (EHRs) and other clinical systems, in the service of educating learners, enhancing quality improvement programs, and improving the healthcare system.
- Educational technologies should be designed to include features that enable, support, and enhance educational research both within and across health professions education programs and the healthcare system.
- Technology developers should work in active partnership with educational and health services researchers to maximize the utility of technology-assisted instruction and assessment to refine instructional design and improve health professions educational and clinical outcomes.
- Health professions education programs should investigate the novel use of educational technologies, distance education tools, and collaborative/social networking strategies to foster the development of competence in interprofessional teamwork that includes partnerships with patients, families, and communities.

- Simulation technologies should be designed to enable learners to practice both as individuals and as members of interprofessional teams, developing expertise in progressively challenging situations, free from concerns about patient safety.
- Simulation-based preparation should be designed to enable self-assessment, teamwork, and self-regulated learning, which will prepare future clinicians to sustain their lifelong professional development.
- Leaders of healthcare delivery systems and health professions education institutions should convene to discuss how health professions education learners can and do contribute value to the healthcare delivery system. This discussion should address how educational and clinical technologies can be used to further the impact of learners on healthcare value and quality.

Examples

- Nursing students use a mobile handheld electronic portfolio system to capture reflections on clinical cases at the point-of-care and provide real-time updates to remote preceptors.
- Virtual patients created by actual patients and their families provide speech-language pathology students with multiple opinions and access to cutting-edge treatments (<http://sig16perspectives.pubs.asha.org/article.aspx?articleid=1775534>).
- Virtual patients are used widely in clinical education to fill gaps in clinical exposure, and to provide learners the important experience of evaluating undiagnosed patients.
- The IBM WatsonPaths project has created an ‘EMR Assistant’ that uses computer

intelligence to help providers uncover key information from patients’ medical records, in order to help improve quality, efficiency, and the steps of clinical reasoning leading to a final diagnosis (<http://www.research.ibm.com/cognitive-computing/watson/watsonpaths.shtml>).

Recommendation V

Leaders of health professions education programs should employ technology to analyze community and population data and use those data to continuously inform the design of curriculum content and learning experiences to reflect the contemporary health and healthcare needs of society.

- Educational technologies should be used to collect data that support educational programs’ focus on community needs and priorities.
- Health professions education faculty should leverage health informatics tools to directly support quality improvement activities (e.g., by aggregating clinical and financial data and facilitating analyses to identify local health needs).

Examples

- Indiana University has created a teaching EHR that is a clone of an actual clinical care EHR, populated with panels of patients for students to manage with information gleaned from de-identified patient data.
- In New York University’s *Healthcare by the Numbers* curriculum, students conduct their own “big data” analysis of public data on over 5 million New York hospitalizations to understand social determinants of health (education.med.nyu.edu/ace/sparcs).

Recommendation VI

Educational technologies should be used to facilitate the sharing of content and integration of data across systems and programs, thus promoting the scalability and adoption of efficient and effective educational strategies.

- Leaders of health professions education programs should work collaboratively across their educational, clinical, and research missions, and in partnership with technology developers, to implement technical standards for sharing data among the electronic health record, learning management system, and longitudinal learning portfolio. Connecting these systems will lead to an ecosystem of applications and data that drives continuous improvement of educational programs, individual learners, and our healthcare delivery systems.
- Electronic learning and computer-based assessment systems should be designed to permit learners and faculty to access/extract their learning data “anytime, anywhere.” Such data portability will allow them to maintain a continuous academic portfolio as they cross the boundaries of programs and institutions.
- Health professions education programs should adopt educational technologies that will facilitate easy repurposing, re-sequencing, and reuse of content to adapt to different contexts, types of learners, educational objectives, and economic circumstances.
- Accreditation and regulatory bodies should leverage educational technologies to simplify and streamline compliance with the educational standards and professional requirements they oversee (licensing, registration, certification), and enable transferability/reciprocity

across jurisdictional and organizational boundaries.

Examples

- Mayo Clinic is using EHR-integrated education to standardize clinical practice and automatically document practice-based learning by providers.
- “Infobuttons” embedded within the EHR provide nurses with patient-specific education and links to medical evidence.
- The Vanderbilt KnowledgeMap system performs real-time analysis of medical student clinical notes and maps them to the curriculum (knowledgemap.mc.vanderbilt.edu/research/).
- Tufts University’s TUSK is an open-source curriculum management system and content repository for health sciences that enables interprofessional curriculum development, linkages to competencies, and easy sharing of content across disciplines and institutions (www.opentusk.org).
- The National Council of State Boards of Nursing established the Nurse Licensure Compact to expand interstate mobility of nurses to practice in other compact states through a single multistate license issued by their home compact state. An electronic licensure information exchange system enables implementation and tracking of regulatory compliance across state jurisdictions (www.ncsbn.org/nurse-licensure-compact.htm).

Conclusion

Wherever care is delivered there must be ongoing teaching and learning, and all participants including patients should be considered both learners and teachers. These recommendations are designed to leverage technology to build a continuously learning health system for the future. In this system, all learners—from novices to advanced practitioners—will be empowered to shape learning opportunities for their own needs, guided by qualitative and quantitative feedback data from faculty, clinicians, and learners. Also in this system, the purpose of education is learning that improves patient experiences, patient outcomes, and the health of the public.

Our six recommendations focus on the use of technology in the creation of a learning system to enhance the education of all health professionals. We need leaders to guide this system transformation, and we need wisdom to help identify which technologies are appropriate for which programs, cultures, topics, teachers,

and learners. And we need skilled technology professionals to create new technologies where existing ones are not sufficient or optimal.

We believe that technology—guided by leaders and enabled by appropriate organizational, governance, reimbursement, and regulatory processes—will allow us to create the incentives and the culture for building a continuously learning health system.

This new system promises nothing short of a revolution in health professions education and healthcare delivery. The continuously learning health system acknowledges and celebrates the natural symbiosis that can and should exist between health professions education and healthcare delivery. Even though they have evolved separately, they now must be integrated on behalf of patients, families, and communities to fulfill their mutual social contract to improve the health of the public. We are at an optimal moment in time to align all these factors and harness evolving technologies to achieve these goals. We must seize this opportunity now.

Table 1: Representative Educational Technologies Used in Health Professions Education⁴

Technology	Examples in Health Professions Education (HPE)
Technologies for face-to-face instruction	
Audience response systems (ARS)	Nursing students may use ARS to provide immediate feedback on interactive quizzes.
Electronic whiteboards ("SmartBoards")	Used to augment live lectures that broadcast the instructors' "chalkboard" drawings to remote learning sites.
Generative learning activities	Medical students in a problem-based-learning course collaboratively authored wikis to teach each other in small groups.

⁴ This is an abstracted version of Table 1 from the commissioned paper "Educational Technologies in Health Professions Education: Current State and Future Directions," by Cook and Triola. These examples are intended for illustrative purposes only and their inclusion does not connote endorsement. The paper and full table can be found in the conference monograph, to be published by the Macy Foundation in the fall of 2015.

Technology	Examples in Health Professions Education (HPE)
Technologies for online instruction	
Augmented reality and virtual learning environments	Augmented reality devices have been used during basic science lectures to enhance the experience with clinic-based patient interviews and exam findings.
Learning management systems	HPE programs use a variety of commercially available products to support both live and online course administration.
Learning objects and course materials	Many HPE schools use online learning modules and supplemental online course materials.
Massive open online course (MOOC)	Health professions educators have created MOOCs on rural health nursing and the healthcare system.
Medical visualizations	3D anatomy simulators are used to teach complex anatomic and dynamic physiologic topics in new ways.
Mobile devices and apps	Several HPE schools are issuing mobile devices to learners; both faculty and students are developing apps and resources for teaching and assessment.
Technologies for simulation-based instruction	
Mannequins	Lifelike full-body and torso models of a complete human are in broad use for clinical education in all HPE fields.
Part-task trainers and workstations	Anatomical physical models that simulate a portion of the body or simulators used to train specific clinical tasks (e.g., interventional cardiology, laparoscopic surgery).
Virtual hospitals	Some hospitals maintain simulated clinical spaces, such as operating and emergency rooms in which learners can practice teamwork, communication, and clinical workflows.
Virtual patients	Virtual patients developed through a collaboration involving a non-profit and national education organizations are in use in more than 90% of medical schools.
Virtual reality (VR) simulators	VR simulators, which provide an immersive sensory experience that simulates a physical place, have been used to practice teamwork and emergency incident response.

Technology	Examples in Health Professions Education (HPE)
Technologies for assessment, evaluation, and administration	
Curriculum mapping tools	Schools are increasingly using these tools to support “mapping” a curriculum. Doing so helps identify redundancies, gaps, common themes, and other opportunities for improvement across classes and program years. Mapping also facilitates connecting course objectives to competencies and milestones.
Computer-aided assessment	In broad use across HPE, these strategies include computer-based quizzes, exams, and assessments. Advantages include automated grading, instant feedback, multimedia and interactive questions, enhanced security, and automated analytics.
Learning analytics	Analytics are being used to answer complex questions about effective teaching and learning, and to render suggestions to optimize education for both individual students and educational programs.
Learner portfolios and coaching systems	Many schools are using portfolios to facilitate the assessment of, and reflection on, information about learners’ educational achievements, performance, and progress.
Technologies that integrate with clinical practice	
Bedside clinical technologies	Clinical technologies are being used by HPE learners to collect data in real-time from patients at the bedside. Learning how to accurately capture and interpret clinical data will enhance patient-centered education.
Point-of-care learning	Academic medical centers are leveraging EMRs, clinical decisions support systems, and computerized provider order entry systems to not only deliver care, but to teach learners about systems, populations, and healthcare quality.

Participants

H. Thomas Aretz, MD

Partners HealthCare International

John Baker

D2L (Desire2Learn)

Marni Baker Stein, PhD

*The University of Texas System
Administration*

Janis (Jan) P. Bellack PhD, RN, FAAN*

MGH Institute of Health Professions

Norman B. Berman, MD

MedU

Geisel School of Medicine at Dartmouth

David Blumenthal, MD, MPP

The Commonwealth Fund

Benjamin K. Chu, MD, MPH, MACP

*Kaiser Foundation Health Plan, Inc.
and Hospitals*

David A. Cook, MD, MHPE

Mayo Clinic College of Medicine

Jeffrey B. Cooper, PhD*

*Harvard Medical School
Massachusetts General Hospital*

Rishi Desai, MD, MPH

Khan Academy

K. Anders Ericsson, PhD

Florida State University

Erica Frank, MD, MPH

*The University of British Columbia
Faculty of Medicine*

Shiv Gaglani

Osmosis

*Johns Hopkins University School of
Medicine*

Deborah C. German, MD

*University of Central Florida
College of Medicine*

Jean Giddens, PhD, RN, FAAN

*Virginia Commonwealth University
School of Nursing*

John P. Glaser, PhD

Cerner Corporation

Vivek Goel, MD, CM, MSc, SM, FRCPC

University of Toronto

Louis M. Gomez, PhD

*University of California, Los Angeles
Graduate School of Education and
Information Studies*

Peter Goodwin, MBA

Josiah Macy Jr. Foundation

Maryellen E. Gusic, MD

Association of American Medical Colleges

Ryan Haynes, PhD

Osmosis

K. Ranga Rama Krishnan, MB ChB

Duke-NUS Graduate Medical School

Gerri Lamb, PhD, RN, FAAN

*Arizona State University College of Nursing
and Health Innovation
Herberger Institute for Design and the Arts*

Mary Y. Lee, MD, MS, FACP

Tufts University School of Medicine

Catherine R. Lucey, MD

*University of California, San Francisco
School of Medicine*

**Mary (Beth) E. Mancini, RN, PhD,
NE-BC, FAHA, ANEF, FAAN***

*The University of Texas at Arlington College
of Nursing*

Haru Okuda, MD

Veterans Health Administration

Sally Okun, RN, MMHS

PatientsLikeMe Inc.

Charles G. Prober, MD*

Stanford University School of Medicine

Stephen C. Schoenbaum, MD, MPH*

Josiah Macy Jr. Foundation

William Stead, MD

Vanderbilt University School of Medicine

Gail W. Stuart, PhD, RN, FAAN*

*Medical University of South Carolina
College of Nursing*

George E. Thibault, MD*

Josiah Macy Jr. Foundation

Marc M. Triola, MD, FACP*

New York University School of Medicine

Sandriijn van Schaik, MD, PhD

*University of California, San Francisco
School of Medicine*

David Vlahov, PhD, RN, FAAN

*University of California, San Francisco
School of Nursing*

Warren F. Wiechmann, MD, MBA

*University of California, Irvine
School of Medicine*

Stacy L. Williams, PhD, CCC-SLP

Allied Health Media

Staff

Yasmine R. Legendre, MPA

Josiah Macy Jr. Foundation

Ellen J. Witzkin

Josiah Macy Jr. Foundation

Teresa Cirillo

EMCVenues

Teri Larson

Teri Larson Consulting



JOSIAH MACY JR. FOUNDATION

44 East 64th Street, New York, NY 10065

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