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Looking Ahead: The Dynamic Nature of Health Systems Science, Future Trends, and the Role of Learners as Change Agents

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IN THIS CHAPTER

This chapter explores the inherently dynamic nature of health systems science as a developing domain and field of inquiry. It explores future trends in health care and how they are influenced by societal, system, physician, and other health care professional trends. It delves into the potential impact of these trends on the health care system and the resulting implications for health professions education, including health systems science. Finally, it briefly examines the role of learners as change agents. The authors view learning as a key activity of all members of the health care delivery system and believe this will impact future changes in health professions education and training. In the spirit of futurism, this chapter also takes a nontraditional approach to exploring these possibilities.

Learning Objectives

1. Provide the rationale for viewing health systems science (HSS) as a dynamic and evolving domain and field of inquiry in terms of focus, knowledge, attitudes, and skills.
2. Articulate several future trends and their possible implications for the health system and for health professions education, including HSS.
3. Examine the role of learners as change agents—for patients, the health care system, and the future of HSS.

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I. Health Systems Science—A Dynamic, Rapidly Developing Domain and Field of Inquiry

6:00 a.m., MAY 15, 2041; CITY 11, BLOCK 25, HOME OF ALEX, A MEDICAL STUDENT:

Alex was excited, even though he knew he shouldn't be. It had been 3 days since the most recent outbreak of Abrac Pox Virus had been detected. He was only nearing the completion of his first year of medical school, but everybody with even a minimum of medical training was taking part in some way in the actions needed to stop this epidemic from spreading farther.

The epidemic had been detected by a citywide alert system that not only linked the electronic records in physician practices and other health settings but also pulled key data from devices worn by people to track their health status and from purchase records of over-the-counter (OTC) medications. The first suggestion of an impending epidemic was a significant decrease in the average number of steps people at highest risk for this infection were taking and the amount of sleep they were getting. These data combined with increases in sales of seventh-generation OTC nonaddictive pain relievers and anti-itch creams triggered the alert. For some, Abrac Pox Virus was nothing more than a minor nuisance, like a summer cold with an inconvenient rash. For others, the infection could be deadly. Health care professionals were ready for the first severe case when the patient contacted his primary care physician through a secure messaging portal that simultaneously displayed holograms of the patient and measured several key vital signs and biometric indicators. While the physician was assessing the patient virtually, augmented intelligence (advanced artificial intelligence) suggested that Abrac Pox Virus was a possibility. The man was quarantined in his own home, and the appropriate treatment was delivered securely to his door.

Today Alex, as part of his training, would be accompanying his preceptor Dr. Bella and others studying other health professions to deliver vaccines and treatment, as appropriate, to Block 43, a neighborhood on the other side of City 11. This area was diverse and challenging, with both very wealthy people and those on the other end of the socioeconomic spectrum. Social determinants of health had been addressed for the past 20 years, but differences remained that affected health, disease, and well-being. Alex's team, along with others, have to get prevention and treatment out promptly or people will start dying.

The goal of this textbook is to enhance the education and training of health professions students, faculty, and other individuals interested in advancing their knowledge and skills in health systems science (HSS), with the ultimate aim of improving the health of patients and populations. Each chapter of this book is intended to provide an overview of useful, applicable information and concepts in HSS—the third medical science—as part of an integrated triad with

the basic and clinical sciences. Competence in HSS is necessary for practitioners to proficiently serve patients in both current and future health care environments. The story of Alex and the Abrac Pox Virus that begins before this section continues throughout the chapter and demonstrates how HSS makes stopping this future epidemic possible before anyone dies or is severely affected by this fictional virus. The domains of HSS range from patient safety to teamwork to social determinants of health, though all are rooted in systems theory. Physicians and other health care professionals with awareness of HSS principles are better positioned to ensure that patients, communities, and populations achieve optimal health outcomes.

HSS should not be viewed as a static set of domains and processes. Rather HSS is a dynamic, developmental, contextually based paradigm that will demand transitions in focus, curricular objectives, knowledge, attitudes, and skills as the domains of science it represents change, evolve, morph, and are created de novo. For example, who would have predicted 50 years ago that electronic media would be as central to most people's professional lives as it is today? Who can predict how electronic health records and other clinical informatics will develop in the next 50 years? Critical discoveries of the last decades in the basic sciences that have gone “bench to bedside,” such as genomics, are often outpacing HSS elements—from ethics and policy to financing. HSS needs to constantly evolve. Physicians and other health care professionals engaged in lifelong learning need to incorporate these developments into their practice of medicine as quickly and seamlessly as possible.

The future is impossible to predict, but it is wonderful to speculate. It is also critical that current health professions students and practitioners prepare themselves for whatever develops if they are to be effective in providing powerful preventive and curative services. Having a framework that includes HSS should assist in this preparation. The gap between changes in the health care system and developments in health professions education must be as narrow as possible, and the catalyst for transformation may come from either direction. The area of value-added educational interventions illustrates this; students are capable of providing population-based interventions that can change the function and outcomes of the health care system.

Viewing medical education as an element of the health care delivery system provides a new perspective on the goals of, and processes for, training. This textbook has elucidated multiple challenges in the current system, potential drivers of suboptimal performance, and strategies for improvement. If the system is not performing at its best, gaps in education and how to fill them should be considered. Anticipating the future of the health system enables agility in educational approaches to better integrate learning with care delivery.

In a learning system, all learners work and all workers learn—and this dynamic should begin early and continue throughout one's professional lifetime as part of lifelong learning for the master adaptive learner. Some medical

schools are now implementing early experiences in HSS, reminiscent of the movement in the latter half of the 20th century to implement early clinical experiences into what was a predominantly basic science curriculum during the first 2 years of medical school.

For example, Penn State College of Medicine has successfully incorporated a core course in HSS that simultaneously pairs conceptual learning in the classroom with experiential learning in the health system.¹ First-year medical students within a few of months of entering medical school engage in value-added roles by serving as patient navigators across the health care system. Similarly, at the University of California, Davis, School of Medicine, a select group of students admitted to an accelerated primary care track begin a longitudinal preceptorship experience almost upon entry to medical school.² They immerse themselves in a practice setting and very quickly identify with their roles as advocates and change agents. At the University of California, San Francisco (UCSF), School of Medicine, first-year students learn how to improve the health of populations and effectiveness of health care systems. They are taught early clinical skills and health systems improvement skills and embedded into clinical microsystems where they identify quality improvement and patient experience needs which they can help to address. At the Warren Alpert Medical School of Brown University, students in the dual-degree MD-ScM Primary Care-Population Medicine program participate in the integrated HSS curriculum (with population health, patient navigation, quality improvement, research, and leadership components) throughout their 4 years of study with clinical experiences tailored for their developmental and curricular stage.³

Health professions learners across the full educational continuum are co-creators of the evolving health care system and its alignment with the future of HSS. The drive to prepare systems-ready caregivers will also involve facilitating the development of systems-ready patients who will increasingly engage in bidirectional communication and shared decision making for individual decisions and for those involving the scope and direction of the health care system.

Future societal, systems, physician, and other health care professional trends will dramatically affect HSS. This chapter attempts to identify some of these major trends and how they might influence the future of the field.

II. Future Trends and Their Implications for Health Systems Science

A. Societal Trends

1. Demographics—Population Change

7:00 a.m., MAY 15, 2041; IN TRANSIT TO BLOCK 43: While in transit to Block 43, Alex, his preceptor Dr. Bella, and the others on the team review the demographic data on the area, an educational module on Abrac Pox Virus, and strategies for containing an outbreak. They are not traveling to-

gether but are able to have a virtual meeting to discuss potential strategies. Their augmented intelligence tools constantly provide graphic input as to the spread of the outbreak, the spectrum of cases, and the resources immediately available for prevention and treatment, as well as analysis of data and therapeutic options.

Everyone living in Block 43 has at least some access to a base level of health care, although the top 15% of earners have the most access. Vaccination rates are lowest at the bottom because structural issues such as lack of transportation or technology interfere with accessing care. There are also competing priorities, including accessing food and care for ongoing chronic conditions, that can take precedence over preventive care.

Vaccination rates are equally low among top earners because although Abrac Pox vaccines have an excellent safety record, untrue stories about side effects have been circulating and increasing resistance to vaccination. In addition, about 10% of the population are recent immigrants. They do not speak the language of the team or others who live in the neighborhood, and although interpretation tools are easily available, there are pockets of mistrust about the use and potential abuse of this technology. Other challenges in the neighborhood include an elderly population (average age 109), some of whom are socially isolated but who are at high risk of death if they contract this virus.

Abrac Pox Virus is highly contagious. It only takes two unvaccinated individuals to trigger an outbreak.

Simply stated, US health care providers provide care for the US patient population—and that population is rapidly changing. The US Census Bureau estimates that by 2030, one in every five Americans will be older than age 65 and that immigration will overtake natural increase (the excess of births over deaths) as the primary driver of population growth.⁴ These demographic changes will require physicians and other health care professionals to care for an aging and a more diverse population. Chronic conditions such as heart disease and stroke, cancer, diabetes, respiratory ailments, and arthritis will take up an expanding proportion of the United States' health care effort and health care dollars. Six of 10 Americans have at least one chronic condition,⁵ and the care of chronic disease is one of the leading drivers of the nation's \$3.3 trillion in annual health care costs.⁶ Caring for a growing number of patients with expanding lists of chronic conditions will require significant understanding of and changes to HSS—from health care organization and financing to workforce considerations. In addition, the greater population and ethnic diversity will demand improved language skills, translator services, or both and greater cultural and epidemiologic appreciation of patients and communities who are different from their physicians and other health care professionals.

2. Environmental—Climate Change

7:30 a.m., MAY 15, 2041; IN TRANSIT TO BLOCK 43: One of the main sticking points in the virtual meeting was how to address, if they address it at all, the issue of climate change

in their response. They were going to be down a team member because wildfires in Block 24 meant that one of the nursing students could not leave his home. The rise of 4° in the average temperature in the region over the past 50 years was the reason they were even dealing with Abrac Pox Virus in their area. As their region got hotter and dryer, Abrac Pox Virus and others formerly unknown to the region had been spreading. The response plan had been written in consultation with a physician with more expertise in the disease who lived 7000 miles away but was connected to their information system through the globally compatible electronic health and wellness record. They decided that the current situation was in part created by climate change, but they otherwise did not have to alter their response, although they did have to move fast. A tornado, which previously had been a rare occurrence in the area, was expected that night. They needed to get in, do their best, and get out safely before transit would become impossible for a few hours.

Environmental changes brought on by global warming will have ever-increasing effects on the health of the population and future health systems. Despite political controversy, most of the leading scientific organizations worldwide have issued statements endorsing the findings that climate warming is extremely likely to be due to human activities and that this warming is expected to impact population health. Two former US surgeons general, one nominated by a Republican president and the other by a Democratic president, declared that they “see climate change as a growing threat to the health of all Americans.”⁷ There are clear signs that global warming will have profound effects and that whole societies may fall victim to increased desertification, ever more violent storms, and more widespread flooding and forest fires, with ramifications for health, disease, and health systems. The three sciences of medicine (basic, clinical, and HSS) will need to respond accordingly. For example, greater consideration of the socio-ecological determinants of health and increased training in disaster planning and management may become more routine in health professions education and practice.

3. Distributed Knowledge

7:45 a.m., MAY 15, 2041; IN TRANSIT TO BLOCK 43:

As the virtual meeting continued and the team members got closer to their destination, a student training to become a public health social media specialist revealed her impressions. She had been monitoring the major and minor social media streams for select keywords most associated with this type of outbreak. Her impressions, bolstered by augmented intelligence, were that the outbreak was in the northwest corner of Block 43 among people with first- or second-degree connections to a day care center in a local house of worship that simultaneously met the needs of all religious groups in an atmosphere of peaceful coexistence and mutual respect. (These publicly supported houses of worship and day care centers had been set up across the globe after the widespread religious wars

of the previous decades.) This day care center was not exclusive to those who were religious and was used by many families in the area.

In light of this information, Dr. Bella contacted the day care center and a local pediatrician in a small private practice who provided care for many of these children. The pediatrician sent out an alert to the families in her care and asked for permission to pass on information to the health care team that was coming to their area. The day care center, which had already started for the day, did not close. Rather, it sent out an alert to families and asked permission for the team to provide vaccinations and treatment, if appropriate. Drones that traveled near the speed of sound were already taking off and on their way with the refrigerated medications from a regional pharmaceutical supply depot.

The rise of the Internet, along with social media and innovative movements in medicine, such as shared decision making and the OpenNotes movement (which allows patients to see and even take part in their electronic health record documentation),⁸ has increased access to health information for patients. This in turn has expanded the role of patients as partners in care. This movement is supported by a variety of developments, such as patient-facing medical information and patient support groups via social media. Patient-facing information systems are designed to provide a wide range of computer or Internet-based services that support patient interactions with the health care system.⁹ The current trends in distributive knowledge are likely to expand further with advances in communication modalities and augmented intelligence. Such advances will not only affect doctor-patient communication but may change the structure of interaction, the balance of power, and the nature of decision making in clinical medicine.

4. Advances in Science, Technology, and the Humanities

8:30 a.m., MAY 15, 2041; ARRIVAL AT BLOCK 43:

The team meets at the house of worship in Block 43. The day care center had parent/guardian permission for the team to see 60% of students. The remainder will be seen later that day.

Medical student Alex will administer vaccines. Dr. Bella will treat those showing signs of infection. Chris, a student in genetic and proteomic counseling, is testing children for a particular gene and protein profile. A tiny minority will not be vaccinated because the vaccine would not protect them. Diane, a student in medical engineering with a specialty in 3-D printing, will create custom tools as needed. Her job is especially critical since child-size bodies may not necessarily fit standard equipment.

The team sets up a small instant clinic at the day care center. The self-contained solar- and helium-powered clinic was delivered by hovercraft and has everything they need for a small to medium-size outbreak. They will contact later that day the families of children without parental or guardian consent for treatment or vaccination.

But then Alex notices an alert on his personal device about the possibility of infection elsewhere. The social media public health specialist confirms it. There is another case on the other side of Block 43. Alex alerts the public health network, and the team, for the moment, keeps its focus on the day care center.

The next century is expected to bring unprecedented advances in science, technology, and the humanities that will have profound influences on our lives, on our health care, and in turn on HSS. Dramatic developments in the basic sciences (e.g., genomics and proteomics) are already being applied to the clinical sciences, and new technologies continue to emerge, such as 3-D printing, machine learning (a computer's ability to learn on its own by analyzing data and tracking recurring patterns), and the Internet of Things (IoT—the concept that all technological devices can be connected to the Internet and to each other in union between the physical and digital worlds). The humanities and social sciences are also advancing with greater understanding of everything from communities and the social nature of health and health care to structural racism and its effects on health to the role of empathy and forgiveness. These developments will most likely change both the existing HSS domains and the HSS competencies necessary for functioning in the future health care environment, as well as creating new critical HSS topics.

5. Glocalization

Glocalization is a linguistic hybrid of globalization and localization and is used to describe a global outlook adapted or modified to better fit local conditions. In business, this has been used to refer to a product or service that is developed and distributed globally but is adjusted to accommodate the user or consumer in a local market.¹⁰ This concept is a refinement of the concept of *globalization*, which is considered as involving cultural homogenization with the subsequent domination of one culture or method of doing things over another.

Glocalization entails the interconnectedness of global and local levels. In health care, glocalization recognizes the necessity to tailor relationships, treatments, and messaging to local needs—whether talking about Ebola epidemics or quality control. Such tailoring in health care will require the application of multiple HSS skills and an alteration in worldview that accepts the requirement of fitting approaches to local conditions.

B. System Trends

1. Systems Citizenship

10:00 a.m., MAY 15, 2041; CITY 11, BLOCK 43, DAY CARE CENTER:

Although Alex is only in his first year of medical school, he is very familiar with the concept of systems citizenship, as are the other members of the team. Alex is administering vaccines, and he knows he has to administer as many as possible in a short amount

of time. He won't be able to do that without the help of the day care staff and the members of his team.

He continues to administer vaccines. Alerts keep sounding about additional cases, but he keeps his focus on the task at hand. Other teams are automatically contacted, organized, brought up to speed on the latest developments in the outbreak, and dispatched to the field.

With the evolving understanding of HSS as a core domain of learning and practice, HSS will and must impact the professional identity formation of today's and tomorrow's physicians and other health care professionals—an identity as a systems citizen. The concept of systems citizenship describes a major evolution that needs to occur to realize the potential of HSS. This evolution pertains to the professional identities of trainees and the environment in which they learn and practice and recognizes the unprecedented interdependence and mutuality in professional lives. Representing a departure from the traditional “sovereign physician” identity in medicine, systems citizens embody both the motivations and behaviors embodied in the systems-based practice competency. Originally articulated by Peter Senge, systems citizens build genuine partnerships across boundaries, see patterns of interdependency, discern how a system is functioning, and connect with others to engage in a process aimed at achieving outcomes.¹¹ This conceptual framework translates to learners who become fluent in the language of teams, are knowledgeable across the full spectrum of HSS, and apply systems thinking skills in the process of collaborating, advocating, learning, and leading. They not only care for individual patients, but also know how to perform in developing systems of care and embody the motivation to grow and contribute to the emergence and evolution of the health care system itself. These sensibilities and skills must be nurtured at each level of training and in all health care settings.

2. Addressing Social Determinants of Health

10:30 a.m., MAY 15, 2041; CITY 11, BLOCK 43, DAY CARE CENTER:

As the clinic progresses, the team notices a pattern. The children most likely to have received quick permission to be vaccinated or treated are those with parents with easy access to technology, either because they are not working outside the home or have jobs that permit personal access during work hours. It appears that the children most likely to be infected are from low-income families who do not speak any of the five most common languages in the area and who have inadequate access to nutritious food. The team is concerned that those who need the help the most may be least likely to get it. They agree that, after the initial batch of children is vaccinated or treated, they will huddle to identify strategies to get vaccines or treatments to children who most need it.

Over the past decade there has been an explosion of interest in the social determinants of health and an acknowledgment of their profound impact on health outcomes and disparities (see Chapter 12). The realization that the health

and well-being of individuals, families, communities, and populations is determined far more by variables such as zip codes than medical care has led to new realizations and calls to action. This in turn has led to the founding of a myriad of projects and programs that aim to screen, measure, and intervene in reducing health disparities. Organizations at the local, state, and national levels—from the Robert Wood Johnson Foundation to the Centers for Medicare & Medicaid Services—are rushing into this domain. Multiple tools now exist for screening social determinants; however, the ability to intervene in response to the findings from these assessments—especially when they are in more than one dimension, such as the lack of good housing and education plus inadequate food—remains elusive. In the future, these goals will be achieved through greater collaboration between health and service agencies and more sophisticated social determinant delivery systems. Some projects, such as the Practical Playbook,¹² already highlight examples of partnerships that simultaneously engage primary care and public health in efforts improve population health.

3. Incorporation of Technologies

11:00 a.m., MAY 15, 2041; CITY 11, BLOCK 43, DAY CARE CENTER:

As the team continues to work, the local pediatrician contacts them because an incredibly sick child infected with this virus has just arrived in her practice. This child is now considered the index case for this outbreak. The team hones its focus to the children who spent the most time with this child.

The day care center also adjusts its security cameras to be more sensitive to body heat, tachycardia, and tachypnea, three newer biometric measures affected by this disease. This allows them to screen on a mass scale the people on site for fever. The team responds as appropriate.

Technology is being incorporated into care processes across the spectrum of health care and across all settings—from homes to tertiary care hospitals. For example, information capture is being augmented by wearables, home systems, facial recognition tracking patterns (dietary, activity, medication), and other means. The nearly ubiquitous use of electronic health records is expanding from health care providers to include patients and their families as patient portals and open notes become more routine.⁸ Such innovations will require alterations in HSS elements such as workflows, information flows, and communication. Each technology will have its own challenges, and HSS solutions will be required. Examples of technologies affecting HSS are described in [Box 17.1](#).

C. Health Care Provider Trends

1. Triple Aim/Quadruple Aim

1:00 p.m., MAY 15, 2041; CITY 11, BLOCK 43, DAY CARE CENTER:

The team continues to work even though they have surpassed the maximum number of hours allowed. In order to prevent burnout,

physicians and other health care professionals, including students, are restricted in the number of hours they can work and the number of patients they can see. These restrictions have been suspended in this outbreak.

There has been a growing realization in the United States that the Triple Aim¹⁴ of improving the health of populations, improving the patient's experience of care, and reducing costs is not sufficient to address the major issues in medicine. Although widely accepted as a road map to optimize health system performance, the Triple Aim neglects to recognize that

physicians and other members of the health care workforce report widespread burnout and dissatisfaction. Burnout is associated with lower patient satisfaction, reduced health outcomes, and it may increase costs. Burnout thus imperils the Triple Aim. This article recommends that the Triple Aim be expanded to a Quadruple Aim, adding the goal of improving the work life of health care providers, including clinicians and staff.¹⁵

More recently it has been realized that although personal interventions such as mindfulness training can be helpful, burnout requires structural systematic approaches, not just strategies focused on the individual.

2. Shifting Preferences in Learning Approaches

Learning preferences of students are likely to be recognized further as education and training become more individualized, building on the:

- Differing experiences of students prior to medical education
- Millennial students being accustomed to short bursts and immediate access to information
- Demand for more tailored learning and individualized pathways
- Improved educational information technology platforms that can evaluate, measure, and attend to individual knowledge, skills, and competencies
- Shifts in medical education structure

Health professions education is leaving the confines of the brick and mortar classroom. Online capabilities and advances in information technology have facilitated the expansion beyond the walls of health professions schools and teaching hospitals for the last few decades. This expansion will accelerate. Some, like the editor of *JAMA*, have suggested that the future of medical education in the United States includes, “No walls, no classes.”¹⁶ Such liberation will allow training to occur in varied settings, wherever learning and health care can occur. Students have already voted with their feet in many medical schools where lectures are recorded. Students often watch lectures at home, using higher speeds for sections more easily understood and multiple, slower viewing of sections that are more difficult to conceptualize. Some medical schools accelerate further devolution of the classroom by recording lecturers in studios, without students present.¹⁷ The online learning explosion (from local productions to MOOCs—massive open online

• BOX 17.1 Examples of Technologies Affecting Health Systems Science

Electronic Health Records (EHRs)

As described in Chapter 10, EHRs are rapidly expanding their capabilities in areas that will directly affect health care systems and health systems science (HSS). These include EHRs' rapidly increasing capacity to integrate and abstract records from multiple sites of care to patient safety features (e.g., drug allergies and drug-drug interactions) to data analytics and patient access to records.

However, there are major gaps in particular EHR capabilities that, unless addressed, may deleteriously affect HSS. For example, there is an urgent need for greater EHR accommodation of clinical workflow, interprofessional teams, and decision support tools. In addition, EHRs could benefit by including system-level variables in addition to the routine categories such as history, physical, allergies, problems, and medications. An example of such a system-level variable might be site of care. This item could focus on whether the care was provided at the right place and time for the patient. Such dilemmas arise frequently in clinical practices regarding ambulatory sensitive conditions. Was the patient with disease or complaint X seen appropriately or inappropriately in the emergency department, or could their issues have been better addressed in a primary care or similar setting? A next-generation EHR might alert the care team and suggest transferring the patient to the appropriate setting. Similarly, an EHR program for rural hospitals might assist with decisions regarding the need to transfer particular patients to tertiary and quaternary care settings. Other EHR developments might include interactive holograms, natural language processing, and augmented intelligence.³⁴ Hardware and software developments now make possible the incorporation of wearable technology and smartphone applications into patient care. Further developments are nearly limitless and will affect HSS at every turn.

Nonetheless, it is becoming increasingly apparent that the near-ubiquitous penetration of EHRs into clinical settings is having broad

effects on the communication skills that must be incorporated into health professions education. Health professions schools, however, are lagging in their adaptation of the teaching of communication skills to new settings and new forms of interaction.³⁵ When computers are used in provider-patient encounters they essentially become the "third party" in the consultation room,^{36,37} yet students and trainees rarely receive training in how to optimize communication in these settings or how to actively engage patients in the EHR. EHRs can be seen as affecting all six domains of clinical competency introduced by the Accreditation Council for Graduate Medical Education.^{38,39} This area is ripe for further guidelines, research, and HSS curriculum development, since it has implications for learning across the full educational continuum.

Big Data

The ever-growing capability of clinical information systems to gather, store, and analyze vast amounts of data for individual patients, physician patient panels, or populations opens up infinite possibilities. Aided by advances in the science of data management and analysis, these advances should enable everyone from students to physicians to organizations in converting these vast resources into information and knowledge.⁴⁰

Augmented Intelligence (AI)

AI has been defined as the theory and development of computer systems able to perform tasks that normally require humans, such as visual perception, pattern and speech recognition, and decision making. Unlike other tech tools, AI systems have the capacity to evolve via deep learning. AI offers the opportunity to augment human intelligence; physicians who integrate well with this technology will be most effective. Most immediately there are issues regarding accreditation, liability, informed consent, and bias that need to be addressed.⁴¹

courses) and the "flipped classroom," as well as the expansion and diversification of educational platforms and forums, will likely accelerate in the future. Recently the University of Vermont Larner College of Medicine decided to transition away from lectures to "100% active learning."¹⁸ Such trends will influence the methods and content of learning, including HSS. Similarly, health professions training, to remain aligned with health system needs, will increasingly follow health care wherever it occurs in the community, including in patient's homes. The evolution of clinical care for patient populations beyond the hospital and usual clinic settings to accountable care organizations, patient-centered medical homes, community health teams, and the use of telemedicine and other technologies may further hasten the movement beyond conventional medical school walls. The University of North Dakota School of Medicine and Health Sciences is leading in this area by enhancing medical education through advanced simulation and telemedicine technologies to teach interprofessional competencies along with rural health care skills. Some medical schools are already following in this direction, and more will likely follow.

3. Ensuring Readiness for Roles

In order to ensure readiness of health professions students for roles in the health care system, formal education and role modeling in both educational and clinical settings must be routinely required and provided. To reach the intended audiences in a systematic manner will require both expanding current educators' skills and recruiting a new cohort of educators, especially interprofessional clinicians, as well as creating validated assessment tools for HSS. Such assessment tools may include the gamut of current medical education evaluation methodologies, such as competencies, milestones, and entrustable professional activities. Uses of competency-based educational outcomes¹⁹ range from guiding learning to feedback, evaluation, and certification. Assessment tools must emphasize the key tenets of HSS, encourage lifelong HSS learning, and be translatable into professional behaviors. Proposed competencies for optimizing health care delivery and systems science have been put forward by Lucey,²⁰ and the authors and editors of this textbook have also proposed new competencies. Finally, attention needs to be paid to potential metacognition and cognitive pitfalls in order to devise strategies to help learners overcome them.

4. Collaborative Orientation (Interprofessional Education)

A desire for collaboration, especially in the workplace, is one of the key characteristics of millennials, the generation born from 1980 to 2000 that comprises the majority of the current medical student population and younger physicians.²¹ By 2025, the millennial generation will comprise 75% of the workforce, including the health care workforce. This is a generation that is generally more comfortable working in groups than individually. They tend to be less hierarchical and are not as limited by set ideas about roles. This means they are particularly well suited to work in the interprofessional teams that are increasingly central to the modern health system. Millennial physicians and other health care professionals also are better positioned for more collaborative relationships with patients. They are more likely to ask their patients to come in with their own research, whereas older physicians from other generations may be more dismissive of patient research.

While the current generation of medical students, and in turn the latest generation of physicians, is more interested in teamwork, they are also interested in recognition of the diverse roles within teams. This all means that teamwork and team science will be more important than ever.

5. Structural Competency and Addressing Structural Bias and Racism

Structural competency refers to a medical education and clinical paradigm that recognize the influence of structural-level determinants, biases, and inequities in shaping health. It acknowledges the role that pathologies in social systems have in shaping individual outcomes and encourages learners to actively think about and engage with those broader structural factors. Structural competency encompasses systemic racism, societal stigma, structural violence, and other structural mechanisms. It takes trainees beyond the traditional cultural competency framework, which focuses on provider-patient cross-cultural differences in race, religion, social class, sexual orientation, or other characteristics and misses the broader structural context of marginalization and disparity. Five core components of structural competency have been articulated by Metzl and Hansen²²: “(1) recognizing the structures that shape clinical interaction; (2) developing an extra-clinical language of structure; (3) rearticulating ‘cultural’ formulations in structural terms; (4) observing and imagining structural interventions; and (5) developing structural humility.” Traditionally, clinicians are trained to listen to and act on individualized stories, but structural competency demands the recognition of structural forces impacting a patient’s presentation and interventions on individual, systems, and societal levels. A social medicine case series by the *New England Journal of Medicine* illustrates how structural competency can be integrated into medical education and clinical care.²³

The last few years have witnessed an increased awakening and engagement around diversity issues in the health professions and in health professions training. Part of this includes greater recognition and acknowledgement of structural bias and racism and their effects on workforce diversity, patient care, and outcomes. Race has often been perceived as a biologic variable in the basic and clinical medical sciences, but this understanding is being challenged as more critical thinking emerges. A major driver of these changes can be traced to the power and influence of broader social movements such as Black Lives Matter and #MeToo.

Structural bias and racism in health care impede efforts to promote diversity in the professional workforce and in academia. There is so much further to go in addressing these issues in health care. The statistics remain egregious. The share of African American men entering medicine has hit historic lows,²⁴ and women remain woefully underrepresented in positions of power in health systems. In the United States currently,

only 3% of health care CEOs are women, 6% are department chairs, 9% are division chiefs, and 3% are serving as chief medical officers. This is despite women comprising 80% of the health care workforce and evidence that having women in upper management and on corporate boards is associated with improved financial performance and enhanced accountability.²⁵

Active discussion of race, ethnicity, gender, and culture in health professions education and in medicine is expected to increase over the next decade. This increase will not just be focused on the current “isms”; rather, the emergence of other dimensions and domains of diversity is expected. Some of these are just in the discussion phase, such as socioeconomic status of medical school applicants, sexual identity/preferences, and the use of pronouns. Others are present in other disciplines and fields but have yet to enter the health professions discourse, such as generation gaps, personality types, digital experience, first languages, and life experiences.

6. Admissions to Medical School

As HSS becomes more established as the third science of medicine, health professions schools may rethink their admissions processes and standards to ensure that applicants have the capacity to acquire the knowledge, attitudes, and skills required for success in this field. For example, future requirements for admission may include experience working in teams and information technology skills, as well as courses in health economics and advanced communication. Admission criteria might also include the ability to function in complex adaptive systems, to tolerate uncertainty, and to maintain resilience. In addition, applicants may be screened to ensure they have a modicum of social responsibility and the capacity to be change agents. Tools that have sufficient reliability and validity to select such students will need to be developed. The multiple mini-interview format²⁶ may be an example of a method that could be amplified in its reach. It has already been employed by an increasing number of

medical schools, starting with Michael G. DeGroote School of Medicine at McMaster University in Canada, to help identify desirable behaviors, such as communication skills.²⁷

III. Health Professions Students and Trainees as Master Adaptive Learners and Change Agents

3:00 p.m., MAY 15, 2041; CITY 11, BLOCK 43, DAY CARE CENTER:

As the day progresses, Alex has applied his skills at delivering vaccines rapidly in a difficult situation. He has also learned how to screen out people already sick and send them to Dr. Bella.

The team is now huddling to determine how to get to those who have not yet received vaccines or other care, but they don't have much time. The tornado is still on the way, and they have to get out of the neighborhood within 3 hours or else they will be spending the night. They decide to target children they have not yet reached but who had close, direct contact with the sick-est child in the care of the local pediatrician. This is a time-intensive approach. They have to go to people's homes, but the list is short. They use augmented intelligence to create a map of homes to go to and ways to get there. They start with the closest one, and they will proceed until they are out of time.

Change is ubiquitous and unavoidable in health care. Traditional approaches to education that emphasize only the basic and clinical sciences do not prepare health professions students, trainees, and practitioners for their future careers. Health professions student trainees will need to become master adaptive learners and change agents in HSS in order for them to survive and thrive in the future health care environment and to ensure that individuals, families, communities, and populations receive the best possible care. The Master Adaptive Learner (MAL) concept “describes a metacognitive approach to learning based on self-regulation that can foster the development and use of adaptive expertise in practice.”²⁸ This means health care professionals must be able to rapidly access and interpret constantly evolving data and understand how to use the new information to provide the best care possible to patients and populations.

The creators of the MAL model believe everyone involved in the health professions must develop critical analytic lifelong learning skills in gaining competency in all areas of the medical sciences, including HSS—the right knowledge, attitudes, and skills at the right time and the right place. To achieve this, those behind the MAL model suggest the integration of learning with work processes and the adoption of their model. Learners have been and will continue to be major change agents for health care and health professions education, including HSS.

Students can and do contribute to improvements in patient care. Medical schools around the country have been developing value-added roles for students and trainees that

lead to achievement of the Triple Aim. As suggested by Lin and colleagues,²⁹ change “is desperately needed to translate education into better health outcomes for Americans today.” Both Lin and colleagues²⁹ and Lucey,²⁰ as well as others, advocate for “value-added medical education” where students’ experiential learning experiences can measurably improve health care system processes of care and patient outcomes, adding both value and capacity to the health care system.

An example is the novel academic program at Penn State College of Medicine, detailed earlier, that utilizes medical students as patient navigators. This program is a “win-win” for students and patients since the former learn how to navigate the complex health care system through the patient’s eyes while the latter are helped to overcome hurdles that include insurance issues, medication concerns, and follow-up.³⁰ At UCSF, where much of the pioneering work on value-added medical education began, there are programs to improve patient outcomes through medical education,³¹ leveraging the talents and commitments of students to add value to the care of patients today. Though these efforts must be supervised to ensure that patients and students truly benefit, they hold promise for further student engagement in the health care system. Another value-added role for medical education involves faculty development. The Brody School of Medicine at East Carolina University (ECU) has established a comprehensive longitudinal core curriculum in patient safety, quality improvement, population health, and team-based care.³² To execute and facilitate these curricular changes, ECU has established its Teachers of Quality Academy to provide faculty development in the new competencies. Faculty who are trained in this academy in turn train students. They will both be able to bring their quality improvement projects back to their health systems where implementation should improve patient care for individuals and populations.

Future health care professionals must be able to engage in practice-based improvement and systems-based improvement if they are to serve as change agents for the health system. Such experiences have been relatively common in student-run clinics, 96 of which are said to be operating in the United States according to the Society of Student Run Free Clinics.³³ However, other opportunities should be encouraged to facilitate students gaining experience in this important HSS domain. The innovative programs noted at Penn State, UCSF, and ECU are just a few examples of what is possible. The new University of Texas Rio Grande Valley School of Medicine places medical students at health centers in impoverished rural settlements in unincorporated areas along the United States–Mexico border. Students are taught strategies to support information exchange and empathetic interactions with individuals and diverse groups in multiple settings for numerous preventive health, health maintenance, and health care delivery purposes. This new medical school is in one of the most medically underserved areas of the United States, and its transformative program will improve local practices and health systems, along with

educating the next generation of physicians to be effective in such settings.

IV. Future Directions for Health Systems Science

Since the first edition of this textbook was published in 2016, thousands of copies have been sold around the world, and it has been implemented at dozens of institutions, including medical schools, other health profession schools, and business schools. The *Health Systems Science Review* book has been published to help educators create HSS assessments and students prepare to take them. The American Medical Association has launched the Health Systems Science Learning Series, a set of online modules. Beyond the products that are a direct result of this textbook, HHS is increasingly viewed as the third science, critical to undergraduate, graduate, and continuing medical education.

This textbook must always be a living document evolving with the shifts in the social, scientific, and economic context of health systems and health professions education. The authors envision that students, faculty, and patients will engage in thoughtful dialogue that will spur the further evolution and development of HSS that will be beyond what the authors ever could imagine.

Other individuals and groups also will work to influence the content and direction of this third science. Stakeholders range from social activists and social movements to trainees, physicians, other health care professionals (including interprofessional care groups), social and behavioral scientists, and, of course, patients. All are welcome as HSS develops.

V. Chapter Summary

5:00 p.m., MAY 15, 2041; CITY 11, BLOCK 43, IN THE NEIGHBORHOOD:

The team spends the rest of the afternoon going to people's homes. Some are more amenable to their approach than others. For those who are most resistant, they contact a teacher at the school to have a video conference with the family. This is usually enough to convince them that the team is legitimate.

Finally, the alerts of new cases stop coming. Their work and that of other teams has had the desired effect. The outbreak has been contained. No one died during this one, and it is time to go home.

This chapter has attempted to provide the rationale for viewing HSS as a dynamic and evolving domain and field of inquiry as well as articulate several future trends and their possible implications for the health system and for health professions education. This chapter also examined the role of learners as change agents—for patients, the health care system, and the future of HSS.

Efforts to foretell the future of health care and health professions education in the United States and the world are

pervasive in academia, business, and politics. However, despite prognostications and predictions about the future, many developments will occur that cannot even be imagined now. In these, as in all scientific investigations, “Chance favors the prepared mind” (Louis Pasteur), and a firm grounding in the three sciences of medicine—basic, clinical, and health systems—will provide sound preparation. Whatever happens in the future, it is crucial that these three sciences be integrated in as seamless a manner as possible into the training and lived experience of learners and practitioners, who engage in lifelong learning. Careers and the future of patients, communities, and populations depend on it.

Questions for Further Thought

1. In what ways is health systems science a dynamic, rapidly changing field?
2. What are some of the trends in US health care that currently affect what should be taught in US medical schools?
3. What do you see as the future of the US health care system in 10, 20, and 50 years, and what new knowledge, attitudes, and skills will be required in terms of health systems science?
4. What is “value-added medical education?” What meaningful roles can students play in health care systems to facilitate their learning while contributing to improving health system processes and patient care outcomes?
5. What are the potential benefits to physicians and to the health of patients and populations if all health care professionals master the knowledge, attitudes, and skills in the various domains of health systems science?

Case Study 1

You are a second-year medical student who has decided to set up a free clinic in the underserved community near your medical school. You've pulled together a committee of 20 enthusiastic students and 6 primary care attendings. You and your clinic receive free space from a local community agency and plan to operate three evenings a week, with students from the medical, nursing, and social work schools in the area, as well with the help of faculty who will volunteer their time.

1. What health system issues must you and your colleagues consider and resolve prior to opening and operating the free clinic?
2. What knowledge, attitudes, and skills must you ensure are acquired by students working in the free clinic?

Case Study 2

You are working at a large academic health center in the Midwest that has operated under a fee-for-service model for the last 50 years. During this time, it established large, costly, resource-intensive, specialized medical and surgical services focused on organ transplantation and joint replacements. These units have

been profit centers for the academic institution, supporting much of its teaching and research mission. In the meantime, the health center developed only a rudimentary primary care network, leaving this to a nonacademic rival across town. In the new health care environment, all the insurers in the state move to value-based care with set per-member per-month payments, supplemented by a quality indicator incentive.

1. How might these changes affect the resource-intensive services that suddenly become cost centers? How will the academic health center need to change to ensure its future viability?
2. What population health strategies should be considered?
3. Consider the different roles you may have in this health center. How might these changes affect you, depending on your role?

Case Study 3

You are a young attending physician who has been charged with integrating a new promising technology into your health system. The technology has the potential to reverse end-stage congestive heart failure but has only been used in experimental trials.

1. What health systems science domains must you consider?
2. What should be the first steps in areas such as training, implementation, quality, safety, and finances?

Exercise

Identify one trend in health care that you believe will be particularly important in the near and distant future. Write a paragraph or a list of bullet points about how it will impact you and how you will ensure that the impact is beneficial rather than detrimental. Consider how one or more of the core components of health systems science will impact this trend. Discuss with colleagues—and look for alternative interpretations.

Annotated Bibliography

Bodenheimer T, Sinsky C. From Triple to Quadruple Aim: care of the patient requires care of the provider. *Ann Fam Med*. 2014;12(6):573-576.

This article builds on the Triple Aim of enhancing the patient experience, improving population health, and reducing costs—tenets that are widely accepted as guideposts to the optimization of health care system performance. The authors believe the Triple Aim is insufficient since physicians and other health care professionals report widespread burnout and dissatisfaction, which is associated with lower patient satisfaction, reduced health outcomes, and increased costs. This article recommends that the Triple Aim be expanded to a Quadruple Aim, adding the goal of improving the working lives of physicians and other health care professionals.

Lin SY, Schillinger E, Irby DM. Value-added medical education: engaging future doctors to transform healthcare delivery today. *J Gen Intern Med*. 2014;30(2):150-151.

Medical student education typically ignores current problems in health care delivery and does not address the pressing societal challenges.

Change is desperately needed to translate education into better health outcomes for all people. The authors advocate for “value-added medical education,” whereby powerful experiential learning experiences add value and capacity to the health care delivery system. Medical students can be trained and can become involved in a variety of targeted patient care tasks.

Lucey CR. Medical education: part of the problem and part of the solution. *JAMA Intern Med*. 2013;173(17):1639-1643.

High-quality health care requires that medical educators accept a social contract to reduce the burden of suffering and disease through the education of doctors. “Medical schools and residency programs must restructure their views of basic and clinical science and workplace learning to give equal emphasis to the science and skills needed to practice in and lead in complex systems. They must also rethink their relationships with clinical environments so that the education of students and residents accelerates the transformation in health care delivery needed to fulfill our contract with society.”

Tierney MJ, Pageler NM, Kahana M, Pantaleoni JL, Longhurst CA. Medical education in the electronic medical record (EMR) era: benefits, challenges, and future directions. *Acad Med*. 2013;88(6):748-752.

This article reviews the effects of EMR use on medical learners through the lens of the six core competencies for medical education promulgated by the Accreditation Council for Graduate Medical Education. The authors examine educational benefits and risks of EMR use, discuss factors that promote successful use when implemented in academic environments, and identify areas for optimization and future research on the EMR's role in medical education.

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