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EXPERIENCE REPORT

Learning Health Systems

Geisinger's effort to realize its potential as a learning health system: A progress report

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Abstract

Objectives: In the last two decades, several organizational initiatives have moved Geisinger into closer alignment with the key characteristics of the learning health system (LHS) model. The intent of this experience report is to provide a firsthand view of the potential of the model and of the complex, multifaceted nature of any endeavor designed and implemented to realize that potential.

Methods: After describing Geisinger, we offer a critical self-assessment of our progress toward the goal of becoming an LHS, followed by an account of the challenges.

Results: Geisinger has made incremental but measurable progress in implementing the LHS model, especially in two key domains: in patient-clinician engagement and science and informatics. Other challenges, however, present significant opportunities for additional forward movement, especially with respect to incentives, culture, and leadership.

Conclusion: Becoming a fully realized LHS is and will be a long-term challenge for any organization that embraces this aspiration.

KEYWORDS
learning health system, organizational culture, patient engagement

1 | INTRODUCTION

In September 2014, in its revised strategic plan, Geisinger's research leadership embraced the National Academy of Medicine's (NAM) learning health system (LHS) model as an aspirational goal, along with the aim of making patient-engaged research the default rather than the exception in all Geisinger research involving human participants. Although efforts since then have yielded progress toward these two interrelated goals, the more salient achievement has been a deeper appreciation of the formidable challenges inherent in this ambition, especially in an organization as large, complex, and ever-changing as our own. In this report, we describe the progress and these challenges with an emphasis on the latter.

We begin by clarifying the yardstick of standards against which we measure our progress, that is, the key characteristics of LHS as they are stipulated by the NAM in its 2013 report, *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*.[1] After describing the Geisinger system, we offer a critical self-assessment of our progress toward the goal of becoming an LHS, followed by an account of the challenges. Our intent is to provide interested readers with an experiential view of the potential of the model, but perhaps more importantly, we also wish to provide an equally experiential

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perspective on the complex, multi-faceted nature of any organizational endeavor designed and implemented to realize that potential.

2 | NAM LEARNING HEALTH SYSTEM MODEL

The evolution of the LHS model is rich in inspiration and guidance for individuals, groups, and organizations that are motivated to undertake the twin challenges of implementing the model *and* of assessing progress along the way. A brief overview of that evolution is useful in explaining our rationale for using the NAM's work and specifically, for the purposes of assessment, the "characteristic features" of the LHS model that the Academy lays out in *Better Care at Lower Cost: The Path to Continuously Learning Health Care in America*.

Although the precise origins of the LHS model are debatable, certainly two milestones in its "prehistory" are, one, the upsurge of scholarly interest in organizational learning that occurred in the late 1970s and is reflected in the work of Chris Argyris and Donald Schon and, two, the 1990s publication of Peter Senge's *The Fifth Discipline: The Art and Practice of the Learning Organization*, which secured the concept of a *learning organization* in the canon of contemporary theories of management, human resources, and institutional leadership.[2,3] Senge's title is a reference to systems thinking, one of the five disciplines—along with personal mastery, mental models, shared vision, and team learning—that learning organizations intentionally and consistently seek to cultivate within themselves. Systems thinking is a holistic approach to the diagnosis of organizational problems that sees these challenges as the unintended products of often hidden, complex interactions among a system's elements *and* that utilizes collective intelligence, team-based learning, and collaboration to formulate and implement integrative strategies to modify these interactions—and in and throughout the process, to learn and improve.[4]

It is this emphasis on systems thinking that forms a conceptual bridge *from* Senge's work to the ever-growing body of work that the NAM initiated in 1999 with the publication of *To Err Is Human* and that the academy continued 2 years later with its 2001 publication, *Crossing the Quality Chasm*; both of which were not just predecessors to, but were more importantly, *foundational* to *The Learning Health System: A Workshop Summary*, the first report in the now long series of NAM reports on the LHS.[5-7] In *To Err Is Human*, the NAM argued that systems thinking is integral to strategies anchored to the goal of improving both the prevention and the response to medical errors. Only systems thinking can reveal the hidden intersections among differing faults in systems and processes that create vulnerabilities in the patient safety net and place patients, as well as the clinicians who care for them, at the risk of error. In *Crossing the Quality Chasm*, the subsequent companion study to *Err Is Human*, the academy continued to apply systems thinking to its diagnosis of other quality deficits in American health care, eg, the fragmentation of health care services, the lack of coordination, the waste of resources, the failure to utilize existing evidence, etc. In that same work, moreover, the academy began to move beyond analyzing the ills of health care in the United States and forward by envisioning a framework of aims and principles for the fundamental redesign and improvement of the system—including the aim of being patient-centered and several principles that prioritize the needs and values of patients, who are to function, in the new system, as the "source of control" in their own care.

Six years after *Crossing the Quality Chasm*, the NAM issued *The Learning Health System: A Workshop Summary*, the first report in the LHS series. Composed of chapters based on the texts of presentations to a workshop of the academy's roundtable on evidence-based medicine, the report also includes the charter and vision statement for that group: "We seek the development of a learning healthcare system that is designed to generate and apply the best evidence for the collaborative healthcare choices of each patient and provider; to drive the process of discovery as a natural outgrowth of patient care; and to ensure innovation, quality, safety, and value in health care."[7] Since then, the academy has sought to unpack and elaborate upon this succinct definition of an LHS, often by exploring its implications for particular specialties (eg, genomics), particular participants in learning (eg, patients and communities), and particular types and sources of learning (eg, observational studies).[8-10] As the NAM has continued to pursue this exceptionally productive line of inquiry, other organizations—notably the Agency for Healthcare Research and Quality (AHRQ)—have taken up the cause of promoting the LHS model, defining it for themselves and extending the work into important domains, for example, by defining the core competencies for individuals who seek to advance the LHS agenda in their own organizations.[11] Because of these and other initiatives, the LHS has become a prominent focus of policy discussions, research funding opportunities, and an array of diverse, practical efforts by health systems—for example, to build new organizational structures (eg, departments of learning sciences) and to augment faculty expertise in such learning disciplines as the dissemination and the implementation sciences.

Nonetheless, in the evolving literature, as well as in common usage, the meaning of an LHS has become somewhat diffused, which is often the outcome of the natural evolution that concepts, models, and ideas undergo as they engage individuals, groups, and organizations in differing contexts and with differing experiences, motivations, and objectives. For example, the authors frequently encounter the belief that Geisinger *is* a *fully realized* LHS, a belief that seems based on the system's possession and deployment of extensive, high quality clinical data resources and on its reputation for innovation in genomics and other areas. It is a belief that, to our minds, reflects a thin definition of the LHS, one that tends to focus on the generation, sharing, use, and application of data and evidence in the processes of caring for patients. Those of us who have been directly engaged with Geisinger's LHS initiative are reluctant to confirm this belief (and thus implicitly endorse this thin definition), although we are more than willing to affirm that we have embraced the model as an aspirational goal—*that we have not yet fully achieved*. This reluctance and this willing affirmation of the goal are both rooted in a thicker definition of the LHS model, a definition found, as we have indicated, in the specific iteration of the model that we have adopted as our guide, ie, the

model whose key characteristics are stipulated by the academy in the 2013 consensus report, *Better Care at Lower Cost: The Path to Continuously Learning Health Care in America*. In this report, the NAM groups these key characteristics into four domains: science and informatics, patient-clinician partnerships, incentives, and continuous learning culture (Table 1).[12] Why did we choose this definition? Why did we embrace this thicker definition a description of the LHS? In retrospect, we did so, at least in part, simply because the origins of our own initiative in 2013 coincided with the publication of this report: at the time, we read it and were deeply influenced by it, in part, because it offered a clear, perhaps even compelling way of identifying the organizational assets critical to becoming an LHS, along with the organizational deficits and barriers that we would have to surmount in moving forward. This rationale received some validation a year later when Geisinger's research enterprise revised its strategic plan and embraced the LHS and patient-engaged learning as aspirations, at least for that organizational mission. At Geisinger, the pairing of these two goals reflected not only excitement with the work initiated in 2013 but also with a cluster of initiatives that shared the common aim of bringing patients into a broad range of learning activities, including discussions about providing patients with access to progress notes in their electronic medical records, about decisions surrounding the return of clinically actionable genomic results, and about other then-novel programs and projects.

Thus, although the features for which Geisinger has achieved a national reputation—eg, the collection, curation, and strategic use of clinical, genomic, and other data—are, indeed, essential functions in any system that aspires to be an LHS, these features alone are insufficient; and so, too, is a reputation for innovation in particular fields or domains of contemporary health care and health care research (eg, genomics), no matter how justified. Our own experience confirms the message implicit in the cited table: the path to becoming a fully realized LHS is arduous and navigating it successfully, making progress along the way, demands coordinated efforts and initiatives on the multiple, interrelated fronts represented by the four domains of science and informatics, patient-clinician relationships, incentives, and culture. It demands, as well, a degree and quality of leadership that we will expound upon when we move to describe the challenges to progress and the barriers to success. In the following, we use the key characteristics of the LHS, organized into these four domains, as a yardstick for assessing Geisinger's progress toward the aspirational goal of becoming an LHS. We will also address a topic—ethics and oversight—that has significant implications for at least three of the four domains, ie, science and informatics, patient-clinician relationships, and culture.

3 | GEISINGER AND THE LHS MODEL

Geisinger's origins as a nonprofit, integrated health care delivery system date back to the founding in 1915 of its flagship hospital, Geisinger Medical Center, in Danville, Pennsylvania. Sixty-six years later, in 1981, the flagship hospital joined with the Geisinger Wyoming Valley Medical Center, located in Wilkes-Barre, Pennsylvania, to form the Geisinger system. In 2013, the then two-hospital system embarked upon a period of rapid growth and expansion. Today, Geisinger includes 13 hospital campuses, an addiction treatment center, a 550 000-member health plan, a medical school, and other facilities, staffed by over 30 000 employees, including 1800 physicians. The system now spans a geographic area reaching from central and northeastern Pennsylvania to southern New Jersey, serves 3 million residents, and provides care to approximately 1 million patients annually. One-third of these patients are ensured by the Geisinger Health Plan (GHP), which creates a "sweet spot," enabling Geisinger to pilot

TABLE 1 Characteristics of a continuously learning health system

Science and Informatics
Real-time access to knowledge-a learning health system continuously and reliably captures, curates, and delivers the best available evidence to guide, support, tailor, and improve clinical decision making and care safety and quality.
Digital capture of the care experience-a learning health system captures the care experience on digital platforms for real-time generation and application of knowledge for care improvement.
Patient-Clinician Partnerships
Engaged, empowered patients-a learning health system is anchored on patient needs and perspectives and promotes the inclusion of patients, families, and other caregivers as vital members of the continuously learning care team.
Incentives
Incentives aligned for value-a learning health system has incentives actively aligned to encourage continuous improvement, identify and reduce waste, and reward high value care.
Full transparency-a learning health system systematically monitors the safety, quality, processes, prices, costs, and outcomes of care, and makes information available for care improvement and informed choices and decision making by clinicians, patients, and their families.
Continuous Learning Culture
Leadership-instilled culture of learning-a learning health system is stewarded by leadership committed to a culture of teamwork, collaboration, and adaptability in support of continuous learning as a core aim.
Supportive system competencies-a learning health system constantly refines complex care operations and processes through ongoing team training and skill building, systems analysis and information development, and creation of the feedback loops for continuous learning and system improvement.

and better assess the outcomes of quality-enhancing, cost-reducing innovations.

In the last two decades, several organizational initiatives have moved Geisinger into closer alignment with the key characteristics of the LHS model. In 1996, in a then forward thinking move, Geisinger converted from paper to electronic health records (EHR). As a result, Geisinger is now able to deploy, for the purposes of learning and improvement, clinical data resources of exceptionally high quality—resources that facilitate clinical decision support at the point of care, as well as abundant opportunities for the full range of learning activities, from research to innovation and quality improvement. In the mid-2000s, Geisinger began to garner widespread attention for two clinical innovations in patient care: *Proven Health Navigation*, an endeavor focused on building an advanced, patient-centered medical home for chronic disease patients; and, *ProvenCare*, a model for optimizing the effectiveness and costs of care for specific procedures and interventions (eg, coronary bypass grafts and knee and hip replacements) and conditions (eg, chronic obstructive pulmonary disease and perinatal care).[13] In 2007, with partial funding from the Pennsylvania Department of Health, Geisinger established a biobank to advance health-related research, especially in genomics and genetics; since then, the MyCode Community Health Initiative has grown into one of the world's largest biobanks and programs for genomic discovery and precision health, with more than 250 000 consented participants, all Geisinger patients, approximately 2% of whom are predicted to receive clinically actionable genomic findings relevant to their own health care through the genomic screening and counseling program, which incorporates principles and features of the LHS model.[14,15]

It was not until 2013, however, that Geisinger took the first step toward an explicit, intentional alignment with the LHS model. In that year, an ad hoc multidisciplinary working group—with representatives from clinical innovation, bioethics, quality and safety, research and compliance, pediatrics, and health services research—formed around the goal of realizing the system's potential as an LHS. This ad hoc effort received additional stimulus from the 2014 revision of Geisinger's research strategic plan, a 6-month process that yielded two primary recommendations: one, that Geisinger embrace the LHS model as an aspirational goal, and two, that patient-engaged research become the default rather than the exception for research involving human participants. These two goals were conceived as interrelated, in part, because of the emphasis given to patient engagement in the NAM's 2013 report and because, as we have indicated, several largely uncoordinated initiatives across the system, both within and beyond the research enterprise, had begun to use patient-populated advisory groups, focus groups, surveys, and other methods to elicit and incorporate patient input into policy development, quality improvement, and clinical innovation.

In 2015, the working group published a paper on its framework for operationalizing the LHS in an integrated health care delivery system; and in 2016, it published another paper describing the perspectives of Geisinger leadership on the LHS model.[16,17] Also in 2016, with funding from the Patient Centered Outcomes Research Institute (PCORI), Geisinger convened a symposium on *Enhancing Patient- and Family-Centered Care through Learning, Discovery, and Engagement*, which brought together nearly 300 patients, clinicians, and investigators for the purpose of developing a conceptual map for practically linking and integrating Geisinger's endeavors on three interrelated fronts: one, realizing the institution's LHS-related goals; two, improving the experience and quality of care; and three, advancing patient engagement in research. Finally, in 2018, Geisinger established the Steele Institute for Health Innovation with a blueprint that incorporates some of the key features of the LHS model.

4 | PROGRESS

In the 5 years that have passed since its explicit embrace of the LHS model, Geisinger has made incremental but measurable progress in implementing the LHS model, especially in two key domains: in patient-clinician engagement and science and informatics (and with respect to this latter domain, we mean deploying informatics to improve care and empower research). The system has also made strides in addressing the ethical questions that often emerge in navigating the complex oversight issues inherent in the model. Finally, although we remain faithful to the ambitious, longer-term goal of becoming a fully realized LHS, we have adopted, as a more proximate and achievable aim, the goal of identifying, studying, and spawning local learning health activities, of which there are now several examples, most of which have the organizational form of relatively specialized institutes and centers. (See Table 3 for a list of these local learning health activities.)

4.1 | Science and informatics

Geisinger continues its advancement of and investment in data, health information technology, and other novel approaches to identify learning and improvement opportunities at the point of care and throughout clinical (as well as research) operations. Table 2 below identifies key examples of how Geisinger is deploying science and informatics to implement the LHS model, advance learning, and spur improvement.

Geisinger's data environment collects and curates clinical and administrative data from several sources across the system, including the EHR and claims; one of the system's richest data assets is the information stored electronically, much of it as structured data, on more than 5.5 million Geisinger patients dating back to 1996. Since 2016, Geisinger has significantly expanded its informatics and data science capabilities by migrating its comprehensive data assets into a “big data” enterprise data warehouse infrastructure based on Apache Hadoop. The enterprise warehouse aggregates clinical, financial, and social determinants data from over 100 sources, including the epic EHR.

At Geisinger, another priority focus in science and informatics entails the acquisition, curation, and strategic use of patient-reported outcomes (PRO). A growing number of PRO assessments have been

TABLE 2 Science and informatics examples of a learning health system

Artificial intelligence and machine learning	Defines enterprise-wide strategies for AI/ML tools, methodologies, talent and resources, inclusive of the co-development and design with partners.
Robotic process automation	Reduces cost, increase revenue and automate operations and processes across business lines. Examples areas include revenue management, human resources, and patient access.
Behavioral insights	Uses behavioral science to make healthy choices easier and A/B tests those interventions to ensure expected effects.
Unified data architecture	The data enterprise supports the health system and health plan operations and clinical care delivery by providing routine and on-demand analytic reports.
Patient reported outcomes	PROs are health related outcomes that are directly reported by the patient who experienced it. Geisinger has over 35 questionnaires in production with many efforts underway to increase that number.

TABLE 3 Geisinger learning health care local initiatives

Genomic Medicine Institute
Autism & Developmental Medicine Institute
Steele Institute for Health Innovation
Kidney Health Research Institute
Obesity Institute
Center for Pharmacy Innovation & Outcomes
Center for Translational Bioethics
Center for Oncology Research & Innovation

launched in recent years that enable patients, their family caregivers, or both to provide care-relevant information at home or before, during, or after clinical appointments. Clinical innovators at the Geisinger Steele Institute are aggressively addressing the potential of patient-generated data captured outside of clinical appointments. For example, they are developing digital prototypes, including mobile applications, for collecting information directly from patients, their caregivers, and their clinicians in order to illuminate and better understand the "lived experience" of the users, all with the aim of moving away from fee-for-service models to value-based care in which reimbursement is based on health outcomes.

Moreover, clinical innovators, researchers, and administrators are investing financial and human resources in developing health care- and operations-focused applications for artificial intelligence (AI), machine learning (ML), and business process automation (BPA)—all of which are emerging technologies that bring clinicians and operational leads together with engineers, data scientists, and implementation scientists to remove waste from workflows across the continuum in order to free the health care workforce to focus on the most important aspects of their roles. The AI and ML projects are able to leverage not just EHR data but also imaging and genomic databases to generate high-impact, clinically actionable technologies. Business process automation follows workflows and business logic and automates processes in areas such as revenue management, patient access, and human resources. Successful automation is a function of a change management process that ultimately begins at the front lines and employs a team-based approach.

Also of note is the Behavioral Insights Team (BIT) that operates across the clinical enterprise under the auspices of the Steele Institute: in close collaboration with clinical partners, the BIT develops and tests "nudges" for patient or care team members; that is, by presenting choices in ways that make it easier for them to make the healthier choice (such as adhering to medication) or an equally healthy, but less expensive, choice (such as prescribing generics), while leaving them free to make a different choice if they prefer. These nudge interventions are informed by psychology, behavioral economics, and decision science and are rigorously evaluated through pragmatic field experiments (aka A/B tests) to ensure that they have the anticipated effects. The BIT also investigates stakeholders' attitudes and reactions to nudges that are clinically and operationally implemented.

4.2 | Patient-clinician engagement

Like many hospitals and health systems, in recent years, Geisinger has prioritized efforts to improve patient experience with patient satisfaction survey results serving as the primary metric for measuring success and identifying areas in need of remedial attention. Although such efforts constitute an important source of learning in the service of improvement, they alone are insufficient as mechanisms for consummating the multifaceted partnership that an aspiring LHS seeks to cultivate and sustain with its patients. Such a system seeks to engage patients as active partners with clinicians in their own care. As an important step in this direction, Geisinger was among the first to promote, implement, and evaluate OpenNotes, the practice of sharing clinician progress (and other) notes with patients directly, usually via a patient portal.[18] In addition to engaging patients in their own care, an LHS also seeks to engage patients as substantive contributors to the processes by which care is advanced and improved—through research, quality improvement, and innovation. To this overarching end, in recent years, Geisinger has

- established Patient and Family Advisory Councils (PFAC) at its hospitals: these councils serve as forums for eliciting patient and family perspectives on multiple dimensions of health care and for enlisting the members as substantive contributors to the quality

improvement process. For example, in light of evidence indicating that inadequate caregiver preparation is a risk for post-discharge re-admissions, the PFAC at the system's flagship hospital conceived, designed, and published a "caregivers' handbook" for the caregivers of patients who have just been discharged. Some specialized centers that integrate research and care have also formed patient advisory councils, including the Obesity Institute, whose patient advisory group was instrumental in extending its mission from pediatric to adult obesity, noting that that mission is "active at any size."

- Enlisted patients as funded investigators of research study teams, especially on funded grants awarded to Geisinger by PCORI.
- Appointed patients to oversight bodies: patients now serve on Geisinger's Institutional Review Board, as well as on the MyCode Ethics Advisory Council, an independent group composed of four "expert" members (ie, expert in genomics and ethics) and five patient members.

Patients and their family members have also been enlisted as sources of both testimony and leadership for safety improvement efforts: for example, as invited discussants at department-based morbidity and mortality conferences and as co-leads, with a physical therapist, in a hospital-based falls-prevention team.

In addition, under the auspices of the Steele Institute, many initiatives in clinical innovation now incorporate "design thinking" in the developmental process. Design thinking is a human-centered approach to creative problem-solving that seeks to align the potential of technology and the imperatives of health care organizations with the needs of patients and clinicians.[19] Stanford's design thinking model, which is a creative solution-based approach to solving problems, has a five-step process: empathize, define, ideate, prototype, and test. The first phase begins with empathy.[20] "Empathy" is pivotal to health care innovation: understanding the "lived experience" of end-users is critical to defining the problem that the innovation seeks to solve. To achieve empathy, such methods as interviews, observations, and focus groups are utilized, for each, with practice, allow us to enter into experience of others. From there, the team "defines" by synthesizing all the information gathered in the first phase. Outputs are often personas, journey maps, and key performance metrics. The third phase is "ideation," where cross functional teams begin to innovatively challenge common assumptions about the problem statement that was defined earlier, with the goal of generating all possible solutions. The fourth phase is "prototype." In Geisinger's product innovation team, wireframes of software applications that users could click-through are produced. And finally, the fifth phase is to "test" what was created with end-users. In summary, design thinking is patient engagement in action: for clinicians, innovators, and staff, it brings empathy and awareness to the challenges of designing, developing, and prototyping solutions that emphasize shared meaning for patients and clinicians, rather than technology solutions that, while elegant, do not ultimately address and resolve the problems identified by both patient and clinician.

One additional initiative is worthy of note: in early 2019, PCORI awarded Geisinger a "capacity building" grant to fund the design, development, implementation, and evaluation of two intersecting curricula: one, the *Patients to Partners* curriculum, will enroll patients with a keen interest in becoming integrally involved in research, quality improvement or innovation; the other, an *Engaging Patients Effectively* curriculum, will enroll clinicians and health researchers who are committed to enlisting patients as partners in their work. The LHS model provides the overarching framework for the two curricula, which intersect at key junctures, bringing patients together with clinicians and health researchers for the purposes of learning collaboratively and beginning the work of building authentic partnerships.

4.3 | Ethics and oversight

At Geisinger, interest in the LHS model was first spawned by ethical issues and questions in the oversight of learning activities, ie, research, quality improvement, innovation, and hybrids of these. As that interest evolved, faculty in bioethics and staff in research and compliance joined forces to educate the IRB for optimal functioning in an environment increasingly aligned with that model, a process that has necessarily been responsive to changes in the common rule. Much of this process has focused on training IRB staff and members in the conduct of rational, evidence-based assessments of risk: within an LHS, risk looms large among the considerations important to oversight determinations.[21] So, too, do concerns about patient engagement: how, when, where, and why should patients be engaged in a given learning activity and, specifically, what does the nature of this activity suggest or indicate about patient consent? Should it be informed, opt-in consent? Would some form of opt-out consent be ethically sufficient? Or is it the case that consent may be waived by the IRB?[22] The next step in this effort is to augment the IRB with an advisory body that can better facilitate, track, and evaluate the whole spectrum of learning activities, from research to quality improvement to innovation. This advisory body is also envisioned as a forum for improving communication within the organization about learning activities that have been launched (and perhaps concluded) with the aim of broadly distributing information about both successes and failures, utilizing, for example, an accessible database or share-point site that could include protocols, study designs, abstracts, and/or publications of potential use to others as they begin to conceive and develop their own proposals for research, quality improvement, or innovation.

4.4 | Local learning health care initiatives

Geisinger's LHS initiative has evolved within the context of a rapidly expanding system that, like all such systems, has been and must be responsive to the shifting dynamics and mounting demands of the *American* health care system. In addition to brisk growth, Geisinger has also experienced the sort of changes that are endemic to organizations, large and small, including changes in leadership and, as a

consequence, changes in strategic and programmatic priorities. This is the background to our own conviction that achieving the ambitious goal of becoming a fully realized LHS requires a close, sustained alignment between and among leadership at multiple levels of the organization and especially among research, quality improvement, and innovation, which, in turn, require alignment with the clinical enterprise.

While we continue to work to secure this requisite alignment, we have sought ways to continue to make progress, specifically by identifying, promoting, and analyzing *local learning health care initiatives*—which we have dubbed "pockets of goodness."[23] At Geisinger, most of these local initiatives occur within specialized centers and institutes that integrate learning activities into care delivery in a cyclic process of continuous improvement that sets out from the identification and application of evidence-based best practices and ultimately yields indications for improvement, as follows (please see Figure 1):

As for ongoing and next steps, the working group is developing strategies for communicating–for raising awareness about and interest in these initiatives; it is, as well, seeking to understand the factors that enable the "spread" or extrapolation of the elements in this cyclic process. These examples of "pockets of goodness" exemplify one or more attributes of Geisinger's LHS model. One example is Geisinger's Fresh Food Farmacy. Against the background of growing health system interest in the social determinants of health, the Steele Institute's Fresh Food Farmacy became one of the country's first programs to develop and implement a "food as medicine" effort to address this pervasive form of insecurity (along with housing and income). The Fresh Food Farmacy provides holistic services for patients who are food insecure and diabetic by providing education and nutritious foods to help fill the meal gap. The program has yielded significant patient HBA1C improvements and confidence in co-managing their conditions. The Fresh Food Farmacy has a team dedicated to the continuous improvement of the program that are based on analytics and patient feedback. Another example, at the Obesity Institute, the methods and strategies that have been deployed within learning activities focused on the problem of pediatric obesity are now been extended to adult obesity.

FIGURE 1 Elements of local learning initiatives

5 | CHALLENGES

We have already alluded to several challenges that we have encountered since setting out on the path to a LHS. These can be usefully identified and explored utilizing the same four domains invoked in the previous section on progress. At the outset, it is important to acknowledge that a realistic, honest assessment that analyzes the organization in both its depth and its breadth would yield the conclusion that challenges remain in all four domains. We will focus, however, on the two domains in which much work remains to be done, ie, incentives and culture, although with regard to the latter, at the time of this writing, there has been significant, promising movement (and in directions that have potentially beneficial implications for other domains, especially clinician-patient engagement).

First, however, we wish to describe two interrelated challenges that arguably reflect some of the more entrenched, long-standing aspects of organizational culture—aspects that are not unique to Geisinger but, as the literature clearly indicates, have been aspects of health care culture for decades.[24] Both speak to the needs that must be addressed and satisfied if any health system is to advance along the path to becoming a fully realized LHS: the need for effective, committed leadership and the need for internal integration and alignment among organizational missions and functions. As for the first, at Geisinger, we have not yet achieved committed and collaborative leadership for this initiative at the multiple levels of—as well as across—our organization, ie, among the total of approximately 700 individuals who occupy mid- to upper-level leadership positions in the system's hospitals and clinics and in all of its missions and functions. Although most probably have some familiarity with the concept of a LHS and would likely appeal to Geisinger's data resources and its work in innovation in explaining their understanding of the concept and its relevance to the system, relatively few are well-grounded in the four domains that we have used both to spur and to measure progress. This specific challenge is because, in part, of the fact that thus far, only the research enterprise has *explicitly* embraced the model; in other words, although our initiative has enlisted and engaged both leaders and frontline individuals (ie, administrators, clinicians, and investigators) both within and beyond research—in innovation, in quality and safety, and in specific centers and organizational units throughout the system—it has, nonetheless, remained largely within the silo of this one mission and function. This obviously remains a barrier to further, substantial progress and, somewhat ironically, was identified and underscored as such by most of the 40-some leaders we interviewed for our 2016 report on "Leadership Perspectives on Operationalizing the Learning Health System in an Integrated Delivery System."[17]

Without this degree and quality of leadership, it will be difficult, if not impossible, to move forward on another, very closely related front: the integration and alignment of Geisinger's clinical enterprise, its health plan, its initiatives in clinical innovation, its educational mission, and its research enterprise. The need and the requirements here are exceptionally complex: for the integration and the alignment of these fundamental components of the organization depend, to a large degree, on significant changes within each as a necessary prelude to the work around alignment, especially changes in the perspectives of their respective leaders and in the structures of accountability that shape their leadership, as well as changes in the processes of internal communication, work flow design and implementation, etc. And by alignment and integration, we mean alignment and integration *around* the shared purpose of acting and collaborating in a more intentionally orchestrated way to realize the system's potential as a LHS. Several years of sustained effort—but only incremental progress—have led us to this sobering but candid conclusion.

5.1 | Incentives

Like other hospitals and health care systems, Geisinger contends with the ever-present challenge of balancing productivity-based incentives with learning- and care improvement-based incentives. In a recent survey of health care leaders, published in the NEJM catalyst, respondents indicated that the ideal split between the two types of incentives should be 45% for productivity and 55% for care-related learning and improvement.[25] Without clarity around the expectations, accountability, and aspirations for learning and improvement, clinicians are unlikely to feel that any system is authentically invested in these goals—and in rewarding and recognizing them for investing their time and energy in their achievement.

Within the domain of incentives, the NAM report also includes transparency. Here, too, Geisinger has significant opportunities for improvement. The system now makes patient satisfaction results available to the public on a clinician-by-clinician basis and various quality metrics are available, eg, from Leap Frog, as the source of those measures. It has not yet tackled the issue of price transparency, but an effort is underway to inform patients and the public about the critical importance of patient-related and patient-provided data for the full range of learning and improvement activities and about its expanding educational mission and the related implications for the delivery of care. In 2016, Geisinger announced its ProvenExperience program, which is an evolution of the ProverCare portfolio. The ProvenExperience program offers refunds to patients who did not have an experience that was aligned to their expectations around kindness or compassion.

5.2 | Culture

Of the four domains of an LHS's key characteristics, those encompassed in a *continuous learning culture* arguably represent the most difficult to achieve and sustain; they are also the most crucial when it comes to fostering organizational learning and driving outcomes. From Peter Drucker's famously incisive observation that "culture eats strategy for breakfast" to the central finding of a recent nationwide health care leadership survey that "culture, more than anything else, drives performance," the necessity of culture as an object of study and practical reform in any organization is beyond dispute—and, especially for health care organizations, difficult to change.[26]

As we have noted, the LHS model has its more immediate origins in two NAM reports, *To Err Is Human* and *Crossing the Quality Chasm*, both of which revealed and explored the link between the quality of care and organizational culture. The first contained the then-startling estimate that up to 98 000 people die every year in the American health care system and, utilizing systems thinking, argued that the root cause of those deaths is not negligent or malignant individuals but rather failures in communication processes that are, themselves, ultimately a reflection of disrespect between and among health care team members and the related cultural phenomena of deficits in psychological safety, leadership, and accountability.[5,24,27] The fact that since then, the estimates of deaths attributable to medical error have only climbed demonstrates how resistant entrenched health care cultures are to change. *Crossing the Quality Chasm* examined other quality deficits (eg, fragmentation and lack of coordination of care, inadequate applications of known evidence) in light of the normative ideals of patient-centered care and shared, informed decision making, tracing these same problems to defective habits and mind-sets in the culture of health care organizations. Thus, the emphasis on organizational culture in *Better Care at Lower Cost: The Path to Continuously Learning Health Care in America* has direct antecedents in the NAM's earlier work, but the more recent report goes further by underscoring the need for systems thinking and problem-solving as core to any strategy for effective culture change.

In recent months, two major, system-wide initiatives have brought the pivotal importance of organizational culture into focus at Geisinger. One, the advanced caring collaborative, has as its overarching goal improving the quality of care for patients with serious, advanced illness and at the end of life. With evidence and eloquence, Atul Gawande's *Being Mortal* makes clear the complexity of the current problems with that quality—and the necessity of a multi-pronged strategy for resolving them.[28] A "just get patients to fill out advance directives" approach will always be woefully inadequate. At Geisinger, our evolving improvement strategy reflects a systems approach and has three different but interrelated fronts. One is to remove the well-known barriers experienced by clinicians—discomfort and lack of skill with advance care planning and end of life discussions—by using standardized patients to train them in the requisite communication skills.[29] The second is to stratify patients in terms of mortality risk and reserve the full panoply of advance care planning tools only for patients with a limited life expectancy of a year or less. And the third is to exploit the potential of the EHR and its advance care planning module, both to document and to coordinate interventions and activities by all members of a patient's health care team. Given the complexity of culture change and the sheer size of the system, we expect that the

requisite transformation will require at least 5 years to yield sustainable improvements in the quality of care for patients with advanced illness, with three of those years devoted to the intensive education and training of both specialist and primary care physicians and advance practitioners as well as other members of health care teams. In this ultimately broad-based initiative, the system is partnering with Respecting Choices, which is now a component of the Coalition to Transform Advanced Care and which seeks to help systems like our own develop individual, team, and organizational capacities for person-centered health care decision making.[30]

The second system-wide initiative is focused on improving patient safety: on making safety an inherent feature and aim of the system, as the academy urges in *Crossing the Quality Chasm*. Here, too, the "culture" change" strategy reflects a systems-approach and integrates activities and interventions organized within the system's hospitals, within its departments, divisions, and institutes, and across the entire system. For example, safety huddles and leader-led safety rounds, "great catch" incentive programs, and AHRQ's framework, team STEPPs (Strategies and Tools to Enhance Performance and Patient Safety), are being implemented within hospitals and specific departments and institutes, to prevent sentinel events and errors.[31] Improving the system's response to events and errors is the targeted goal for several coordinated programs, including education in the "just culture" approach to addressing clinician involvement in events and errors, training for hospital-based multidisciplinary teams in the effective skills for disclosing events and errors to patients and families, and the implementation of RISE, which stands for "resilience in serious events" and is intended to meet the needs of so-called "second victims," clinicians who are implicated in events and errors.[32] At multiple levels of leadership, accountability for the unprofessional behaviors that have known linkages with patient safety deficits is being clarified and strengthened.

This emphasis on enhanced professionalism acknowledges the fundamental importance of mutual respect and psychological safety, which are not only the necessary underpinnings of a system and a culture of safety. As Amy Edmondson argues in *The Fearless Organization*, these aspirational dimensions of interpersonal relationships throughout a system are also critical to enhanced learning, improvement, and performance, at the individual, the team, and the organizational level.[33]

6 | CONCLUSION

The literature exploring the experiences of other organizations makes it clear that the challenges that we have catalogued here are shared by other hospitals and health care systems like our own.[34] Becoming a fully realized LHS is and will be a long-term challenge for any organization that adopts this aspiration. If we were to distill, from our own experiences, some key lessons, they would be twofold. First, without strong, committed, and collaborative leadership within an organization—especially on the part of the chief executive officer and the executive leadership team—it will be difficult to make significant headway in orchestrating the multiple interrelated initiatives required to move a system along the developmental path toward a fully realized LHS. Second, as the literature indicates, some of the most challenging, difficult work involves changing the culture of health care organizations; this work, which necessarily has a long-term horizon and depends upon the sort of organizational leadership that we have just described, is crucial to developing the environment in which a LHS can begin to take hold and flourish.

We will close by reflecting on our position and our prospects as we seek to move along "the developmental path toward a fully realized LHS." Although we do, indeed, hope and intend to move further along that path, we have come to question whether the goal of a fully realized LHS is ever fully attainable. For we suspect that the reality is that in light of the ongoing dynamic evolution of technologies, the growth of evidence, and other forces of change, the goal of a fully realized LHS, much like the paradox of Achilles and the tortoise, can never fully be achieved because the essence of learning and improvement is—and always will be—a moving target.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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