OPEN ACCESS

Maximizing student potential: Lessons for pharmacy programs from the patient safety movement

Ephrem Abebe [a,b,c,*], Amy Bao [a], Peter Kokkinias [a], Alissa L. Russ-Jara [a,b], Dan Degnan [a]

[a] Department of Pharmacy Practice, College of Pharmacy, Purdue University, West Lafayette, IN, USA
[b] Regenstrief Center for Healthcare Engineering, Purdue University, West Lafayette, IN, USA
[c] School of Medicine, Indiana University, Indianapolis, IN, USA

ABSTRACT

Higher education institutions (HEIs), including pharmacy programs, are experiencing growing pressure from the public and policy makers to develop student-centered learning experiences that meet societal needs. While HEIs may have in-house initiatives to meet such challenges, there are also opportunities for cross-domain learning and application of useful concepts from other sectors. One such sector that lends itself to cross-domain learning is the healthcare industry. Like HEIs, the healthcare industry has been experiencing pressure from its stakeholders, in this case, to address patient safety gaps. These forces intensified at the turn of the century leading to the emergence of what is now known as the patient safety movement, which enabled increased advocacy, education, and research to reduce healthcare-related harm. Despite persistent challenges, a key achievement of the patient safety movement has been application of a systems framework to understand and solve patient safety gaps. That is, patient safety gaps are often a result of system defects rather than isolated acts of individual workers operating in a complex social and technical work setting (often referred to as sociotechnical system). Commonly used systems frameworks describe a sociotechnical system through its components: 1) structure (e.g., people, tools/technology, physical workspaces); 2) processes (e.g., medication administration); and 3) outcomes (e.g., medication safety, patient satisfaction). At their core, both HEIs and healthcare organizations are complex sociotechnical systems that organize their structures to support specific processes - learning in HEIs and patient safety in healthcare - to ultimately improve outcomes for students and patients, respectively. This paper describes parallels between HEIs and the healthcare domain to illustrate how patient safety concepts and practices from healthcare can be adapted to HEIs in order to enhance educational structures, processes, and learning outcomes.

1. Background

Teaching remains among the core missions of higher education institutions (HEIs), and through their teaching mission, HEIs have the critical role of developing tomorrow's workforce that will sustain societies and nations. The practice of teaching is embedded in a sociotechnical system where educators and learners engage in a multitude of relationships, all situated within a complex web of interactions that involve people, organizational contexts, learning environments, and instructional tools. Political and technological forces continue to shape how HEIs organize their work and are viewed by the public. Many HEIs are being scrutinized for the quality of education offered and their contributions towards meeting societal needs. Doctor of Pharmacy programs share the same sector-wide challenges but also face their own unique issues, including the evolving nature of the

pharmacy curriculum and need to prioritize instructional offerings to produce a pharmacy workforce fit for a 21st century practice.

Examining how other sociotechnical systems (i.e., organizations) are responding to external pressures to address quality gaps can be instructive and may lead to insights that might be adapted to HEIs. An example of a sociotechnical system that has been a subject of significant external pressure is the healthcare industry and the forces that led to emergence of the patient safety movement, with the goal of developing sustainable solutions to pressing patient safety gaps. Metaphors used to describe the extent of patient harm due to medical errors, such as a jumbo jet crashing every day, caught the attention of mainstream media, political leaders, scientific community, and the wider public. Influential bodies have also issued policy recommendations with far reaching impacts, a prime example being the then Institute of Medicine's 1999 seminal report: *To Err is Human.*[1] What

* Corresponding author at: Department of Pharmacy Practice, Purdue University College of Pharmacy, 575 Stadium Mall Drive, West Lafayette, IN 47907, USA.
  E-mail address: eabebe@purdue.edu (E. Abebe).

followed was a series of efforts on advocacy, research funding, and innovative strategies to tackle patient safety gaps in diverse healthcare settings.

Indeed, useful parallels can be made between healthcare delivery organizations and HEIs. At the core, both settings strive for services that meet the needs of their primary end users: patients in healthcare settings and learners in HEIs. Healthcare organizations seek to deliver safe and high-quality care to their patients by organizing structures and care processes around this goal. In academia, HEIs also organize their resources to deliver student-centered learning and prepare learners for a fulfilling and productive career following graduation. This paper draws parallels between HEIs and the healthcare domain to illustrate how concepts and practices shown to be successful in healthcare can be adapted to HEIs to enhance structures and educational processes to improve learner outcomes. Although applicable across broad HEI domains, pharmacy-specific examples are provided throughout this commentary to illustrate adaptation of concepts from healthcare into HEIs.

2. Examining the work of HEIs using a systems lens

Among the key contributions of the patient safety movement has been increased recognition of patient safety gaps as a system - rather than individual - failure. Patient safety scholars have argued that a systems lens would be necessary to examine patient safety gaps because safety incidents often occur because of both proximal events (active failures) and a set of underlying conditions (sometimes referred to as latent failures) that create conditions where errors occur.[2] A useful framework to apply a systems lens for understanding safety gaps is the structure-process-outcome model, and its various adaptations such as the Systems Engineering Initiative for Patient Safety (SEIPS) family of models.[3–5] Applying such a model would help one to understand the structure (and its components, such as people, tools/technologies, etc.) as a whole and its influence on healthcare processes, which in turn, impact healthcare outcomes (e.g., patient safety). These models can then inform sustainable and effective systems-based improvements.

By adopting a systems lens, HEIs can also draw useful lessons from the patient safety movement and improve student outcomes. Drawing from the SEIPS model, and as depicted in Fig. 1, the educational system in HEIs can be described using three components: 1) structure: a system comprised of people performing tasks using the available instructional tools and technologies, and within the educational context (e.g., physical learning spaces, institutional policies, social contexts, legislation); 2) processes; and 3) outcomes. Table 1 provides a comparative perspective of selected structure components, processes, and outcomes among higher education and healthcare domains. The paragraphs below focus on a discussion of selected system components to illustrate potential application of patient safety concepts and principles in HEIs.

3. Educational structures

Parallel to the maturation of the patient safety movement in healthcare organizations,[6] Doctor of Pharmacy programs can adopt a systems-lens to examine their structures and ensure alignment with the goal of student-centered learning and better educational outcomes. This means considering all systems components, their settings, and work contexts—from the processes used to accredit HEIs, to dealing with the complexity of technology to support learning and assessment, and managing the traditional hierarchical decision-making processes. Some examples are described here to illustrate application of these concepts.

3.1. Tools/technology to support learning and assessment

Most HEIs use an electronic, learning management system (LMS) to support learning by students. An LMS is an online, integrated software used for delivering, tracking and reporting the academic progress of learners.[7] While most HEIs have migrated to the adoption of LMS systems, the degree to which these systems are integrated with other software used in higher education seems to be limited. Other learning software used in pharmacy education that may not be linked to the primary LMS are assessment software (e.g., Examsoft), experiential scheduling and assessment software (e.g., CORE/ELMS), and various other teaching and learning tools (video-conferencing, Kahoot, Poll Everywhere, etc.). There are other software systems important to the operations of an HEI that could be bundled together to increase visibility of data and support decision making.

Software integration is very similar to the historical perspective of healthcare organizations. Historically, hospitals had a diverse set of software systems that were dedicated to an individualized function within the organization. These might include a software system for the pharmacy, for the laboratory, for the finance department, etc. At the level of individual patient care, this would also mean different software for patient care tasks, such as medication administration (e.g., bar-coded medication administration (BCMA) and infusion pumps), charting patient care activities (e.g., electronic health records (EHRs)), and so on.

In 2009, the concept of "Meaningful Use" was introduced in the U.S as part of the HITECH Act to encourage healthcare providers to adopt more integrated and standardized healthcare software systems.[8] Providers were incentivized through federal payments to make progress in this regard. In 2012, during the initial phases of the program, Farzad Mostashari, M.D., National Coordinator for Health Information Technology, said, "It's what's right for the patient, and our goal as a country to get to better health, better healthcare and lower costs".[9] Today, many health systems have implemented EHRs and integrated software technology to support efficiency, quality and safety. Recently, healthcare organizations have also pursued interoperability objectives to ensure software systems from medical devices
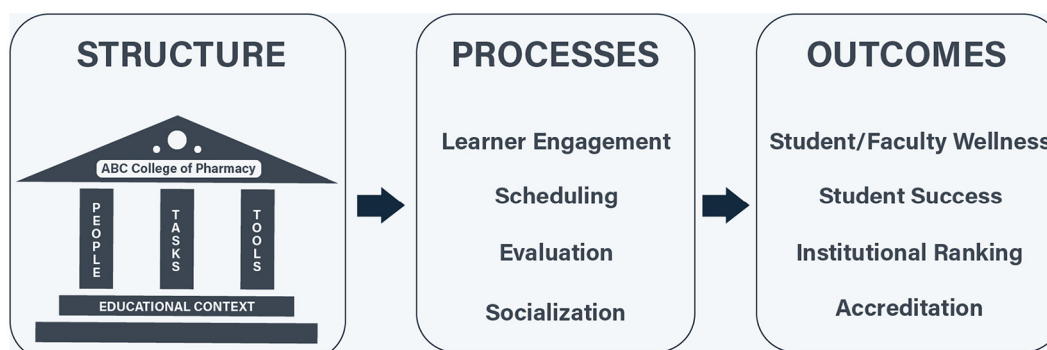

Fig. 1. Educational work system representing structure, processes, and outcomes in a higher education setting. Adapted from the SEIPS model.[3,5]

Table 1

Comparative Perspectives for Structures, Processes, and Outcomes in HEIs and Healthcare Organizations. Examples are for illustrative purposes and do not represent exhaustive list of domain-specific features or activities.

System Components	Examples of System Elements	Domain	
		Higher Education Institution	Healthcare Organizations
Structure	People: *Characteristics of individuals*	Skills, training, and competency levels of faculty; students' own skills and studying strategies, faculty and student workload	Training and competency levels of clinicians; workload
	Tasks:	Lecturing; Exam grading; Advising	Diagnosing; Charting; Patient counseling; Medication administration
	Tools/Technology	Learning management systems; Student feedback technologies; exam/proctoring software; audio/visual technologies used in classrooms.	Electronic health records; infusion pumps; bar coded medication administration systems
	Context: *Accreditation policies and mechanisms*	Bodies for accreditation of higher education institutions (e.g., Accreditation Council for Pharmacy Education)	The Joint Commission (TJC), Healthcare Facilities Accreditation Program (HFAP), Det Norske Veritas (DNV)
	Context: *policies for payment/reimbursement; performance evaluation; staffing*	Government backed loans; Peer review of faculty, promotion and tenure policies, students' course evaluations; Faculty-to-staff and faculty-to-student ratios.	Centers for Medicare and Medicaid Services (CMS); Star rating, safety grades; provider rating; patient satisfaction ratings; Clinician to patient ratios
	Context: *Organizational culture*	Administration-faculty-staff-student power gradients; tradition and history	Intra- and Interprofessional hierarchies, residents vs. attendings. Type of safety culture, such as just culture.
	Context: *Physical Space and Working Environment*	Lecture halls; collaboration spaces; Study rooms; Faculty offices; Noise, Temperature; Light; Distractions	Patient rooms; Medication rooms; Waiting areas; Noise; Temperature, Light; Distractions
Process	Assessments	OSCEs, Exams, Quizzes, NAPLEX, pharmacy law exams	Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS)
	Engagement	Flipped classrooms, active student learning	Shared decision-making between clinicians and patients.
	Scheduling	Academic calendar, Schedule of classes, final examinations	Patient appointment timing and length, Staff and resident shifts and working hours
	Accreditation Process	Document and on-site review	Tracer methodology and on-site review
	Socialization	Student culture; Student-faculty relationships	Teamwork and administrative culture, relationships
	End-user Feedback	Students' evaluations of instructors and courses	Safety incident reporting, HCAHPS
	External validation scores	US News and World Report, National Rankings	Transparent score posting by payors
Outcome	Workforce/student success	Tenured faculty and student graduation rates, licensure, first job placement	Organizational workforce loyalty and patient clinical outcomes, workforce turnover rates.
	Wellness	Student, faculty, and staff well-being and resilience, rates of turnover, drop outs, and absenteeism.	Clinician well-being and resilience, rates of turnover and absenteeism.

Abbreviations: OSCE: Objective Structured Clinical Examination; NAPLEX: North American Pharmacist Licensure Examination.

(e.g., smart infusion pumps and bar-coded medication administration systems) are 'talking to' the EHR system. An interesting exercise when contrasting HEIs to LMS adoption and that of EHR adoption in healthcare would be to reimagine Dr. Mostashari's quote through the substitution of higher education terms instead of healthcare. The quote could be as follows "It's what's right for the student, and our goal as a country to get to better [educated], better [higher education] and lower [tuition] costs".

3.2. Context: accreditation policies and mechanisms

In the same way hospitals and other healthcare entities pursue accreditation from organizations such as The Joint Commission (TJC), most Doctor of Pharmacy programs are accredited by the Accreditation Council for Pharmacy Education (ACPE).[10] In many ways, this accreditation is pursued to demonstrate a level of excellence against an established standard. There is also a financial incentive for pharmacy programs to be accredited. ACPE is recognized by the US Department of Education for the accreditation of professional degree programs leading to the Doctor of Pharmacy degree. This allows many schools and their students to receive federal funding to cover operational expenses and student tuition, respectively.

Since 2004, TJC has used the tracer methodology to determine the level of quality of an individual healthcare organization and its associated accreditation status.[11] At its core, the tracer methodology uses direct observation techniques, rather than a structural review, to identify quality issues. The tracer methodology used by TJC includes having a surveyor follow a healthcare process to determine adherence to a particular standard. For example, if a TJC surveyor is observing the patient care process in the Emergency Department of a hospital and a patient requires a procedure in the radiology department, the surveyor may "trace" or follow the patient to the new area to observe handoff procedures and care transitions personally rather than reviewing the policies regarding what should happen when a patient's care is transitioned.

Additionally, TJC surveyors can conduct tracers regarding a patient's care process or across large swaths of a system. The technique is often used to identify communication issues or coordination gaps within organizational silos. The TJC review cycle occurs every 3 years, while the ACPE survey cycle may be up to every 8 years per organization. The ACPE accreditation process is structured in a similar way to the previous TJC process, which involves a review of the organization's curricular approach and a review of an organizational self-study.[12] On-site accreditation visits are frequently structured as interviews or small group meetings to review policies and reported data. The tracer methodology is seldom used to observe processes during the ACPE accreditation process but could be valuable.

3.3. Context: organizational culture

In the dynamic environment of providing healthcare, patients and providers have had to adapt to new technologies and ideas quickly. In many cases, workflow was altered to incorporate new processes or technologies. Higher education and healthcare's need to adapt to a changing environment has never been more evident than during the current pandemic.[13] Many healthcare organizations that have a focus on safety have adopted the principles of high reliability organizing (HRO). The concept of HROs was made popular by the Weick and Sutcliffe book *Managing the Unexpected*.[14] There are 5 key principles that high reliability organizations commit to that are likely missing in HEIs[15]: 1) Preoccupation with failure; 2) Reluctance to simplify; 3) Sensitivity to operations; 4) Commitment to resilience; and 5) Deference to expertise. For example, the principle of "deference to expertise" states that those who complete the work are often the most knowledgeable about the task. In most cases, this means valuing expertise and experience over hierarchical rank and involving those closest to the work in shaping the organization's processes. In healthcare HROs, this can lead to what some may perceive as "bottom up" decision making rather than a "top down" approach.

For the most part, HEIs have traditionally relied on the organizational hierarchy to provide both operational management and strategic direction for their institution. At times, not deferring to expertise may hinder an HEIs ability to rapidly respond to a new challenge.

4. Educational processes

Like in healthcare, the structures within HEIs are organized to support a myriad of processes that support student learning. Although many such processes can be identified, this paper will point to three prototypical processes and discuss parallels with healthcare settings. In doing so, lessons will be drawn from the patient safety movement to illustrate how they can be applied to enhance educational processes.

4.1. Learner engagement

Within HEIs, education can involve the processes of instruction and course design by faculty, as well as the scheduling of classes and examinations for students. In the clinical setting, education may involve patient education, as well as the education of healthcare providers in residencies or other comparable post-graduate trainings. One area of education that can always be improved upon is increased engagement of learners. In the realm of healthcare, shared decision-making has been promoted as a method to improve patient care by striking a balance between patient education and patient engagement, as opposed to the paternalistic model where a healthcare provider makes all decisions on behalf of the patient.[16] Not only does this result in better health outcomes, but also higher levels of patient satisfaction and empowerment.[17] Similarly, many HEIs are now gradually transitioning away from traditional lecture-based teaching methods, to adopt active-learning style curricula.[18] Although both of these methods have been shown to improve health and education outcomes, they are often limited by the physical design of the traditional lecture hall, the challenges of training educators and clinicians to properly engage in these methods, as well as the reliance on students and patients to take responsibility in being actively engaged in the process.[17–20]

4.2. Learner assessment

Another area of education that can benefit from improvement is the scheduling of trainings and assessments. Students in HEIs are known to have poor sleep schedules, especially around examination periods. Healthcare workers, especially medical residents, are also notoriously known to be subject to long work hours and sleep deprivation.[21] With fatigue and sleep deprivation being proven to impair various cognitive functions, there is no doubt that patient safety and learning outcomes can both suffer as a result of sleep deprivation.[21,22] In the early 2000s, as emerging research detailing the connection between fatigue and decline in clinical performance coincided with the patient safety movement, agencies such as The Joint Commission and Institute of Medicine began to call upon healthcare organizations to revise their work hours and develop fatigue mitigation strategies.[21,23] The Accreditation Council for Graduate Medical Education subsequently revised its work hour standards to place limits on work week hours, shift duration, and required days off, and studies have shown that medical residents now experience increased well-being and quality of life.[23]

In education, students share some responsibility for their time management and study habits to prioritize their sleep, but they often have no control over course assignment deadlines and exam schedules. A study of sleep patterns among student pharmacists found that 81.7% of students obtained less than the recommended seven hours of sleep the night before an examination,[24] and to make matters worse, many HEIs will have final examinations for multiple courses densely scheduled into a "finals week" at the end of the semester. Studies have shown that student outcomes may be improved when learning content is spaced out and learners have more control over the process.[25] Within pharmacy programs, instructors could coordinate their exam schedules so students have no more than a couple

exams or major deadlines per week. We have begun to use this approach within our program. Additionally, it could be helpful to students' sleep to distribute assignments and workload more evenly throughout the course duration. For example, based on student feedback for one of our courses, we shifted an assignment to occur earlier, within the first 3 weeks, when student workload is less. A study examining pre-examination sleep patterns in undergraduate students in Uruguay found that sleep duration and academic performance both improved when examination start times were delayed (8:00 AM versus 11:30 AM and 1:15 PM).[22] It may be worthwhile for HEIs to also space their final exams over a period of time longer than a single week, as well as shifting examination start times to later in the day, as to maximize the amount of sleep that students may get before an examination. While nights prior to examinations tend to be the most common occasion for insufficient sleep, a large percentage of students may also experience daytime sleepiness on a regular basis.[24] Studies have found that delaying school-day start times by about an hour results in lower rates of daytime sleepiness and tardiness in adolescents, so one may reasonably assume that if lecture start times are shifted to later in the day, students in HEIs will also be better rested.[26]

4.3. Evaluation

Student evaluations of faculty and courses may be comparable to healthcare safety incident reporting in many ways. Both types of feedback are essential for assessing the efficacy of current systems and identifying areas for improvement. Students, however, may not be motivated to complete evaluations thoroughly, if at all, if they feel their responses will not result in any real improvements to the course.[27,28] Likewise, safety incidents are widely known to be underreported by providers, and one of the most cited barriers to healthcare incident reporting is the feeling of lack of follow-up about what safety improvements have been implemented.[29,30] "Safety action feedback loops" have been utilized within the realm of incident reporting to ensure there is a systematic way to update the original reporter about improvements in safety that have been made as a result of their feedback.[29] HEIs could explore the feasibility of implementing similar feedback loops to allow faculty to follow-up with their students, to let them know what feedback was received, and what changes have been made. A recent study of pharmacy students highlights this need, as participants identified feedback from faculty on changes made to teaching materials based on previous student evaluations as an important motivator to complete course evaluations.[27] As one approach, a faculty member within our program addresses this on the first day of class, explaining student feedback from the prior year and what corresponding course changes were implemented.

An additional comparison may be made between student feedback and patient feedback received through satisfaction surveys such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The HCAHPS survey results are used to assess the quality of patient care in hospitals, similar to how student evaluations are used to assess the quality of education received in their courses. The HCAHPS survey has generally been effective in incentivizing hospitals to improve their quality of care, in part because HCAHPS scores determine the amount of reimbursement a hospital will receive from Medicare.[31] Although student evaluations of courses are often considered as part of the criteria for faculty promotion and tenure, the relative value attached to this practice can vary across HEIs and culture of academic units. Creating more transparency and accountability (e.g., publishing the most common student accolades and concerns each semester, etc.) around these processes may incentivize students to provide meaningful feedback, and can increase the likelihood of faculty making perceptible changes based on received feedback.

4.4. Socialization

Socialization, or relationship-building, is an additional process that can be examined in academic and healthcare spaces. Issues with socialization in these settings can lead to poor student performance in academic classes, or

an inadequate culture of safety in healthcare institutions. Students in pharmacy schools and other HEIs have commonly struggled with establishing comfortable relationships with their professors and preceptors. Sometimes, students may perceive instructors to be less approachable when they prefer to be addressed by their title and last name.[32] This may be particularly true during the last year of pharmacy school during a student's advanced pharmacy practice experiences (APPEs). These students may feel frustrated using the title and last name form of address with their preceptors, while other team members at the APPE site are likely to address the preceptor by first name. The dichotomy of being the odd-one-out while working at the site, despite having responsibilities similar to that of a practicing pharmacist, may cause pharmacy students to not feel respected as a true part of the team while at their APPEs, and may lead to feelings of inadequacy approaching graduation. Students who feel their professors are unapproachable may also hesitate to seek help when struggling with their grades.[33] Similarly, the concept of authority gradient exists in healthcare, and has been found to cause patient harm due to apprehensions of junior healthcare workers in speaking up to senior providers about safety incidents.[34] In efforts to reduce the authority gradient, some healthcare institutions have turned to trainings such as Crew Resource Management and TeamSTEPPS, which foster supportive and empowering behavior in leaders to allow them to reduce communication barriers, while still maintaining a command hierarchy.[35] Similarly, faculty at HEIs may attempt to decrease the communication barrier that students may perceive by establishing a welcoming environment at the formation of the teaching relationship. Faculty may still choose to be addressed by their title to maintain respect from students, while also being personable and expressing that they are willing to be a resource for students on an on-going basis.

5. Educational outcomes

Healthcare organizations that demonstrate sustained excellence in quality design their structures and care processes to support a singular goal of providing quality care. Within such contexts, improved patient outcomes may be characterized by using objective and subjective measures of healthcare quality and patient safety, such as reduction in rate of unplanned hospital readmissions, reduced rates of patient harm, and higher patient satisfaction. With well-designed learning structures and processes, HEIs can achieve improvements in objective and subjective measures regarding student and faculty well-being and performance. In pharmacy programs, key objective metrics of improvement include, but are not limited to, student grade point averages (GPA), pass rates for pharmacy licensure and jurisprudence examinations (e.g., NAPLEX and MJPE in North America), accreditation status, and percentage of pharmacy graduates attaining post-graduate positions. Other measures of improvement include student and faculty well-being, resilience, confidence, and safety, which are assessed through regular surveys, course evaluations, and/or questionnaires. During the COVID-19 pandemic, an even greater emphasis on well-being needs to be at the forefront within HEIs to improve student and faculty well-being.

5.1. Student and faculty resilience

Emerging patient safety literature has shown that poor working conditions (often as a result of poorly designed tools, technologies, and care processes) have a detrimental effect on clinician well-being.[36] This concept has great relevance to pharmacy education given the intense demands of the professional curriculum and postgraduate training programs, both on learners and faculty.[37] In addition, the current model for residency program structure has not been conducive for overall wellness due to increased workload and long work hours by residents. Recognizing such gaps, several residency programs have recently begun to implement duty hour limits[38] and resiliency training programs to support residents with coping skills and managing stress. Resiliency training is not the sole answer to the epidemic of burnout but can complement systematic efforts that rethink how structures and processes can be redesigned to improve working conditions. Similarly, Doctor of Pharmacy programs can implement similar measures to

better prepare students and support development of strong resiliency traits throughout their educational journey. Improving students' resilience, which has been measured in Grit S scores, has shown to improve not only their ability to handle stress, but also supports growth during academic journeys. A recent survey study found that students' academic performance increased when their perceived stress was lower due to improvements in multiple noncognitive factors such as grit.[39] Higher Grit S scores were correlated with a higher GPA and attainment of postgraduate training positions.[40,41]

5.2. Burnout

Another potential benefit of student-centered design of learning structures and processes would be improving work-life balance to reduce student and faculty burnout. A concept closely related to resilience, burnout can deter academic institutions from meeting accreditation standards.[12] Burnout has negatively affected the pharmacy profession and employers' ability to retain staff, especially during the COVID-19 pandemic.[42] Faculty are also reporting increased levels of burnout, which has been linked to lower interest in faculty positions and higher attrition rates, potentially leading to poorer quality of education for pharmacy students.[43] A potential solution that has been explored is a redesign of learning structures and processes, such as restructuring of duties or job sharing.[44] Creating better working conditions may contribute to decreased student and faculty burnout, which in turn may lead to improvements in recruitment of student and faculty applicants. In addition, when faculty are better supported in their work, they can deliver a better teaching experience and education to students.

6. Opportunities for improvement in HEIs

Although an exhaustive discussion on individual components is beyond the scope of this paper, the previous sections highlighted the parallels between HEIs and healthcare organizations and how patient safety concepts and practices can be adapted to HEIs to improve student outcomes. HEIs are often the source of cutting-edge knowledge and research conducted within their walls have led to innovative products and ideas that transformed other sectors—including ideas that benefitted the patient safety movement. HEIs have tremendous opportunity for leveraging their in-house expertise to transform the educational experience of students not only by adopting but also by enhancing and building upon useful patient safety concepts and practices. Table 2 highlights areas that may be further explored as potential opportunities for improvement in HEIs.

7. Conclusions and future directions

This commentary described how both healthcare organizations and HEIs operate as complex sociotechnical systems. Both domains have system components—people, tasks, tools/technologies, and contexts—that are organized to support specific processes (e.g., education of patients or students, evaluation of care quality or faculty instruction), with the ultimate goal of improving the worker (e.g., clinician or faculty well-being), the organization (e.g., hospital revenue, accreditation status), and the end user outcomes (e.g., patient safety, student graduation and career success). Despite ongoing challenges, the field of patient safety has achieved some level of maturity, and, over the past few decades, several new concepts have been introduced to improve patient safety. Much like healthcare has learned from other safety critical domains, such as aviation and nuclear power industries, lessons from the patient safety movement may have the potential to inform improvements in educational experience of learners within HEIs.

Pioneers of the patient safety movement understood that safety defects are system problems that demand system-oriented solutions to drive excellence in performance. A system orientation provides a much-needed framework to examine work contexts within HEIs and to appreciate the interplay between structures and processes and their impact on outcomes. As our illustrative examples have shown, HEIs can apply a systems lens—such as

Table 2

Additional Opportunities for Improvement in HEIs.

Topic	Summary
Scholarship of Teaching and Learning (SOTL)	A key success area of the patient safety movement has been increased research efforts and associated funding towards understanding and addressing patient safety problems. HEIs, their academic units, and other stakeholders must commit to promote and actively support SoTL. Such support must include adequate funding and recognition of faculty and student efforts for innovations in learning practice. A key consideration is also application of a system lens when engaging in SOTL research to avoid fragmentation and siloed approaches to improvements in learning practice.
Capturing and Visualizing Longitudinal Learning Experience of Students	Similar to how healthcare organizations are using safety dashboards and gathering patient reported data, HEIs can leverage their in-house expertise to develop systems, processes, and measurement tools to document the longitudinal learning experiences of students. Such data can be visualized to support decision making and provide just-in-time information on student learning so timely course adjustments can be made. SOTL research can help define outcomes that are relevant to stakeholders and how they should be measured.
Emerging Technologies to Support Student Learning and Engagement	HEIs are often the source of cutting-edge knowledge and serve as testbeds for innovative tools and technologies before they even make their way into public use. HEIs can leverage emerging arrays of digital tools such as augmented and virtual reality to enhance student engagement and understanding of complex concepts.
Acknowledge and Leverage Students' Social Context	When faculty, staff, and administrators interact with students, the interaction often ignores the student's social context. Individuals within a student's social sphere (e.g., parents, siblings, friends) often have a critical role in the student's growth and learning. It will be key to acknowledge this fact and view students as individuals influenced by their social contexts. These social connections can become key allies to developing strategies and tools to promote student success and well-being.
Collaboration Instead of Competition	Many HEIs, including Colleges of Pharmacy, operate within a framework of competition. Despite their primary mission of training students that eventually join the pharmacy workforce, there is little evidence of collaboration among Colleges of Pharmacy. When collaborations occur, it is often on an individual faculty basis. Healthcare organizations display a similar competitive spirit. Yet there are examples of healthcare organizations that have decided to collaborate for patient safety, by forming coalitions and sharing data, best practices, and strategies. The Big Ten Academic Alliance (BTAA), established in 1958, may also serve as an academic model of collaboration although, despite its long history, it has not achieved deeper collaborations among individual Colleges and academic units of member universities. Colleges of Pharmacy may consider collaboration efforts by first developing a prioritized list of shared challenges. For example, such efforts may begin at a course-level, such as developing core competencies and instructional materials for a patient safety course within pharmacy curricula.

the Structure-Process-Outcome framework—to reexamine their learning structure and how their components can work together to support learning processes and student outcomes.

Funding

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. IOM. *Institute of Medicine to err Is Human: Building a Safer Health System.* Washington DC: National Academy Press. 1999.
2. Reason J. Human error: models and management. BMJ 2000;320:768–770.
3. Carayon P, Schoofs Hundt A, Karsh BT, et al. Work system design for patient safety: the SEIPS model. Qual Saf Health Care 2006;15(suppl 1):i50–i58.
4. Carayon P, Wooldridge A, Hoonakker P, Hundt AS, Kelly MM. SEIPS 3.0: human-centered design of the patient journey for patient safety. Appl Ergon 2020;84, 103033.
5. Holden RJ, Carayon P, Gurses AP, et al. SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. Ergonomics 2013;56:1669–1686.
6. Stokes CD, Brace R. Systemness taps the power of interdependence in healthcare. Front Health Serv Manage 2021;37:17–27.
7. Chaw LY, Tang MC. What makes learning management systems effective for learning? J Educ Technol Syst 2018;47:152–169.
8. Yu PP. Why meaningful use matters. J Oncol Pract 2011;7:206–209.
9. National eHealth Collaborative. *Health Informatics.* 2012.
10. ACPE Programs By State. 2022. Available at: https://www.acpe-accredit.org/accredited-programs-by-state/.
11. The Joint Commission Tracer Methodology. 2022. Avaiable at: https://www.jointcommission.org/resources/news-and-multimedia/fact-sheets/facts-about-tracer-methodology/.
12. ACPE Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree. Accreditation Council for Pharmacy Education; 2015. Available at: https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf.
13. Crain MA, Bush AL, Hayanga H, et al. Healthcare leadership in the COVID-19 pandemic: from innovative preparation to evolutionary transformation. J Healthc Leadersh 2021;13:199–207.
14. Weick KE, Sutcliffe KM. *Managing the Unexpected: Sustained Performance in a Complex World. 3 ed.* San Francisco, CA: Wiley. 2015.
15. Godlock GC, Miltner RS, Sullivan DT. Deference to expertise: making care safer. Creat Nurs 2017;23:7-12.
16. Wagner A, Radionova N, Rieger MA, Siegel A. Patient education and continuing medical education to promote shared decision-making. A systematic literature review. Int J Environ Res Public Health 2019;16.
17. AHRQ. *Strategy 6I: Shared Decision Making.* Agency for Healthcare Research and Quality. 2020.
18. Persky AM, McLaughlin JE. The flipped classroom - from theory to practice in health professional education. Am J Pharm Educ 2017;81:118.
19. Lucas KH, Testman JA, Hoyland MN, Kimble AM, Euler ML. Correlation between active-learning coursework and student retention of core content during advanced pharmacy practice experiences. Am J Pharm Educ 2013;77:171.
20. Thériault G, Bell NR, Grad R, Singh H, Szafran O. Teaching shared decision making: an essential competency. Can Fam Physician 2019;65:514–516.
21. AHRQ. *Fatigue, sleep deprivation, and patient safety.* Agency for Healthcare Research and Quality. 2019.
22. Estevan I, Sardi R, Tejera AC, Silva A, Tassino B. Should I study or should I go (to sleep)? The influence of test schedule on the sleep behavior of undergraduates and its association with performance. PLoS One 2021;16, e0247104.
23. AHRQ. *Duty Hours and Patient Safety.* Agency for Healthcare Research and Quality. 2019.
24. Zeek ML, Savoie MJ, Song M, et al. Sleep duration and academic performance among student pharmacists. Am J Pharm Educ 2015;79:63.
25. Carvalho PF, Sana F, Yan VX. Self-regulated spacing in a massive open online course is related to better learning. NPJ Sci Learn 2020;5:2.
26. Berry KM, Erickson DJ, Berger AT, et al. Association of delaying school start time with sleep-wake behaviors among adolescents. J Adolesc Health 2021;69:831–837.
27. Gupta V, Viswesh V, Cone C, Unni E. Qualitative analysis of the impact of changes to the student evaluation of teaching process. Am J Pharm Educ 2020;84:7110.
28. Tungate SS, Romanelli F. A recent pharmacy Graduate's perspectives on faculty and course evaluations. Am J Pharm Educ 2020;84:8388.
29. Agency for Healthcare Research and Q. Incident Reporting: More Attention to the Safety Action Feedback Loop, Please. Vol. 2022. Agency for Healthcare Research and, Quality. 2011.
30. Evans SM, Berry JG, Smith BJ, et al. Attitudes and barriers to incident reporting: a collaborative hospital study. Qual Saf Health Care 2006;15:39–43.
31. Centers for Medicare & Medicaid Services HCAHPS: Patients' Perspectives of Care Survey. 2022. Available at: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/HospitalHCAHPS.
32. Hildenbrand GM, Perrault EV, Devine TM. You may call me professor: professor form of address in email communication and college student reactions to not knowing what to call their professors. J Commun Pedag 2020;3:82–99.

33. Briody EK, Wirtz E, Goldenstein A, Berger E. Breaking the tyranny of office hours: overcoming professor avoidance. West Lafayette: Purdue University.
34. Cosby KS, Croskerry P. Profiles in patient safety: authority gradients in medical error. Acad Emerg Med 2004;11:1341–1345.
35. Clapper TC. TeamSTEPPS® is an effective tool to level the hierarchy in healthcare communication by empowering all stakeholders. J Commun Healthc 2018;11: 241–244.
36. Committee on Systems Approaches to Improve Patient Care by Supporting Clinician Well-Being; National Academy of Medicine; National Academies of Sciences E, and Medicine. *Taking action against clinician burnout: a systems approach to professional well-being.* Washington D.C: NAP. 2019.
37. ASHP Residency accreditation. 2022. Available at: https://www.ashp.org/professional-development/residency-information/residency-program-resources/residency-accreditation.
38. ASHP Duty Hour Requirements for Pharmacy Residencies. American Society of Health-System Pharmacists; 2022. Available at: https://www.ashp.org/-/media/assets/professional-development/residencies/docs/duty-hour-requirements.ashx.
39. Chisholm-Burns MA, Berg-Poppe P, Spivey CA, Karges-Brown J, Pithan A. Developing a framework of relationships among noncognitive factors in doctor of pharmacy Students' academic performance. Am J Pharm Educ 2021;85:8608.
40. Palisoc AJL, Matsumoto RR, Ho J, Perry PJ, Tang TT, Ip EJ. Relationship between grit with academic performance and attainment of postgraduate training in pharmacy students. Am J Pharm Educ 2017;81:67.
41. Pate AN, Payakachat N, Harrell TK, Pate KA, Caldwell DJ, Franks AM. Measurement of grit and correlation to student pharmacist academic performance. Am J Pharm Educ 2017;81:105.
42. National Academy of Medicine. Clinician Well-being Is Essential for Safe, High-quality Patient Care. 2018. Available at: https://nam.edu/initiatives/clinician-resilience-and-well-being/.
43. Darbishire P, Isaacs AN, Miller ML. Faculty burnout in pharmacy education. Am J Pharm Educ 2020;84 (7):ajpe7925.
44. Sacks J, Valin S, Casson RI, Wilson CR. Are 2 heads better than 1? Perspectives on job sharing in academic family medicine. Can Fam Physician 2015;61(11–13):e11–e13.