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A practical guide for implementing and maintaining value-added clinical systems learning roles for medical students using a diffusion of innovations framework

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Abstract After emphasizing biomedical and clinical sciences for over a century, US medical schools are expanding experiential roles that allow students to learn about health care delivery while also adding value to patient care. After developing a program where all 1st-year medical students are integrated into interprofessional care teams to contribute to patient care, authors use a diffusion of innovations framework to explore and identify barriers, facilitators, and best practices for implementing value-added clinical systems learning roles. In 2016, authors conducted 32 clinical-site observations, 29 1:1 interviews with mentors, and four student focus-group interviews. Data were transcribed verbatim, and a thematic analysis was used to identify themes. Authors discussed drafts of the categorization scheme, and agreed upon results and quotations. Of 36 sites implementing the program, 17 (47%) remained, 8 (22%) significantly modified, and 11 (31%) withdrew from the program. Identified strategies for implementing value-added roles included: student education, patient characteristics, patient selection methods, activities performed, and resources. Six themes influencing program implementation and maintenance included: (1) educational benefit, (2) value added to patient care from student work, (3) mentor time and site capacity, (4) student engagement, (5) working relationship between school, site, and students, and, (6) students' continuity at the site. Health systems science is an emerging focus for medical schools, and educators are challenged to design practice-based roles that enhance education and add value to patient care. Health professions' schools implementing

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value-added roles will need to invest resources and strategize about best-practice strategies to guide efforts.

Keywords Undergraduate medical education · Implementation science · Curricular development · Value-added medical education

Background

As healthcare undergoes significant changes aimed at improving outcomes, both health systems and medical schools must evolve to ensure physicians have the necessary skills to address healthcare challenges (Berwick and Finkelstein 2010; Cooke et al. 2010; Grumbach et al. 2014; Skochelak 2010). Physicians unprepared for practice within health systems will face difficulties in improving health outcomes for individuals or populations. To address the challenge of educating collaborative systems-focused physicians, medical schools are embracing a new three-pillar framework that integrates biomedical and clinical sciences with Health Systems Sciences (HSS), including concepts such as population health, health policy, interprofessional collaboration, and systems thinking (Berwick and Finkelstein 2010; Combes and Arespacochaga 2012; Cooke et al. 2010; Cordasco 2009; Crosson et al. 2011; Gonzalo et al. 2017a; b; Lucey 2013; Skochelak 2010; Skochelak et al. 2016).

To effectively teach HSS, educators need to identify practice-based experiences that augment classroom-based curricula (Gonzalo et al. 2014). Medical schools are experimenting with value-added clinical systems learning roles whereby students contribute to health systems by improving care processes and outcomes while simultaneously learning HSS (Association 2014; Chen et al. 2013; Gonzalo et al. 2014; Lin et al. 2015). These roles are in contrast to current experiential roles that focus on learning doctoring skills from physician faculty within practice settings, which requires time and resources that are sometimes viewed as a liability (Chen et al. 2014; Gonzalo et al. 2014, 2017a; Jones and Korn 1997; Shea et al. 1996). The need to enhance HSS education and develop value-added roles provides an opportunity for medical education to shift from a potential burden to a potentially unrecognized asset (Jones and Korn 1997; Shea et al. 1996; Thibault 2013). Despite potential benefits to students and health systems, little work has explored facilitators or barriers to implementing the kind of value-added clinical systems learning roles that could be widely adopted by medical schools (Lucey 2013). In 2014, we created a large-scale network of sites in which students served in these roles (American Medical Association: Accelerating Change in Medical Education Initiative 2013). Using this network as a laboratory and a Diffusion of Innovations framework, we were interested in identifying practical strategies, key facilitators and barriers to advancing this education agenda.

Diffusion of Innovation is a theory advanced by Rogers to understand how stakeholders in a social system learn about, decide upon, and act on ideas or practices they perceive as new (Rogers 2003; Rohrbach et al. 1993). It is characterized by five stages: (1) knowledge—or planned efforts to make potential participants aware of the new practices, (2) persuasion—or building support for the innovation, (3) decision—or the intention to try the program, (4) implementation—or interventions to assist participants in delivering the new approach as it is aligns with program goals, and, (5) maintenance—or encouragement of participants to continue the innovation. In a prior work, we described early persuasion and

decision techniques (stages 2 and 3) found to be beneficial in this innovation; the focus of this current work was on stages 4 and 5 (Gonzalo et al. 2017c). In alignment with Diffusion of Innovation theory, our design specifically targeted three key stakeholder groups in the implementation and maintenance stages: (1) educational leadership, (2) health system site mentors, and, (3) medical students experiencing the program (Murray 1986; Rogers 2003).

Methods

Study setting and design

In 2014, Penn State College of Medicine (PSCOM) implemented a HSS course that included value-added clinical systems learning roles in the form of patient navigation (Gonzalo et al. 2014, 2017b). Patient navigators hold a unique role in modern-day interprofessional healthcare teams as they identify patients' barriers to care and help patients navigate complex health systems to obtain quality care (Freeman and Rodriguez 2011). The student patient navigator role was designed to provide experiential learning by embedding each student into an interprofessional care team to help address patient needs. In the 2014–2015 academic year, 85 of 150 first-year students were placed across 16 sites, and in the 2015–2016 academic year, 144 of 150 first-year students were placed across 36 sites. Our team's perspective in this study was that value-added clinical systems learning roles are important for medical student education and health care transformation. Although our prior work in this area informed this project, we employed several strategies to assure a de novo exploration. To address our reflexivity, we used several methods in the participant sampling, data collection, and analysis to limit any potential biases in themes or categories (Mauthner and Doucet 2003). All faculty investigators had 3 years of experience with this program, and were sensitized to possible results identified in the data. For example, investigators identified prior to the start of the study that site capacity to accommodate students and student engagement were likely to emerge as key findings. The study was facilitated by three experienced researchers (J.G., D.W., and B.T.) during all phases, including conceptualization, data collection and analysis, and writing of the manuscript. The study was approved by the Penn State Hershey Institutional Review Board (STUDY00005150/STUDY00005278).

Data sources and collection

To ensure credibility of our data and results, we triangulated data from three sources and across several clinical sites and stakeholder groups: field notes from site observations, 1:1 interviews with site mentors, and focus-group interviews with students who had completed the experience (Shenton 2004). One investigator (D.G.), PSCOM's Patient Navigation Coordinator, performed observations at clinical sites (n = 32, January–June 2016); four sites were excluded due to scheduling challenges. During visits, the investigator observed student activities, asked pre-determined questions of students and mentors, and recorded detailed field notes ("Representative field site questions and prompts" Appendix section). Four semi-structured, audio-recorded, focus-group interviews were conducted with 4-8 students, and performed by an experienced facilitator (B.T.) following the students' year as patient navigators (September–October 2016). Students were invited to participate from one of four placement groups: (1) primary care clinics, (2) specialty-based clinics, (3)

underserved/free clinics, and (4) transitions programs; a maximum of eight students was allowed to sign up for each group. Questions related to students' experiences, expectations, types of patients and mentoring at their site, resources needed, barriers, and perceived value to care and education ("Student patient navigator focus-group interview guide" Appendix section). Last, a research assistant experienced with performing telephone interviews conducted 1:1 interviews with mentors who coordinated oversight of student patient navigators (August 2016–January 2017). Questions related to strategies, barriers, and facilitators in implementing and maintaining the program ("Representative site mentor interview questions and guide" Appendix section) (Harting et al. 2009). In addition to qualitative data, we compiled a list of all sites and their status after the 2015–2016 academic year (continued, modified, or withdrawn). All interviews were audio recorded, and a professional transcriptionist transcribed all audio verbatim.

Data analysis

Data from field notes, 1:1 interviews and focus-group transcriptions were integrated into one dataset for the analysis phase. The data were analyzed using thematic analysis to identify categories and themes (Bernard and Ryan 2010; Boyatzis 1998; Braun 2006). Two investigators with experience in qualitative analysis (A.A., D.G.) first independently analyzed one set of field notes looking for phrases or words that recurred frequently to create an initial codebook. Through independent coding and regular adjudication sessions, initial codes were compared for inconsistency and agreement, followed by updating of the codebook. Analysts discussed disagreements, and modified codes as necessary. The unit of analysis was phrases containing one idea (Elo and Kyngas 2008). We used a form of peer debriefing with the individuals who conducted the interviews to help ensure that we were interpreting the meaning of the interviews according to the context that occurred in real time (Mauthner and Doucet 2003). As suggested by qualitative research, we sought to be flexible with emerging data to meaningfully organize results (Miles and Gilbert 2005). In this process, we identified strategies for implementing patient navigator programs, along with barriers and facilitators in accomplishing this goal, all of which were iteratively discussed by the research team. In this process, we developed a Key-Driver diagram of influential areas and strategies to be considered by others in developing and implementing a similar model. The research team discussed the findings and selected quotations (from the transcribed interviews and focus groups only) for inclusion in the results. We used NVivo10 and11 QSR International software to manage the data.

Of the 36 sites implementing the patient navigator program, 32 site observations were completed (mean 4 h per observation; estimated total of 130 h). Four focus-group interviews were completed with 24 students (mean 47 min, range 34–72 min). A total of 29, 1:1 interviews (88% participation rate) with site mentors was performed (mean 28 min, range 21–75 min). A total of 375 pages of double-spaced textual data was analyzed (field notes = 65, mentor interviews = 260, focus-group interviews = 50).

Results

Here we describe characteristics of clinical sites, and core elements, facilitators, barriers, and strategies to improve the implementation and maintenance of a student patient navigator program.

Site characteristics

Of 36 clinical sites implementing the program in 2015–2016, 22 (61%) were affiliated with PSCOM, 10 (28%) were affiliated with a community-based hospital/system, and four (11%) were independent or state-run programs (Table 1). Of 36 clinical sites, 17 (47%) continued the program, eight (22%) significantly modified the program and down- or up-sized the number of students, and 11 (31%) withdrew from the program. Of withdrawing sites, 6 of 11 (55%) were affiliated with a community-based hospital/system, 4 of 11 (36%) were affiliated with PSCOM, and 1 of 11 (9%) was an independent clinic.

Strategies for implementing a value-added clinical systems learning roles program

Our data identified core elements important to implementing and maintaining a value-added clinical systems learning roles program. Table 2 provides examples, based on our data, of the program in four settings: outpatient primary care clinic, specialty-based clinic, free/under-served clinic, and transitions program. Table 3 provides the necessary student orientation and continuous education, patient characteristics best suited for students, patient selection processes, student activities, and resources students could use within each setting. All sites developed educational methods about the site, scope of practice of interprofessional providers (e.g. care coordinators, social workers), and various resources available to patients (e.g. transportation services, community resources). Types of patients and their characteristics were considered in all sites, with patients most "in need" of navigation being a top priority. Patient selection processes were varied and included quality metric reports of superutilizers, provider referrals, and care coordinators' awareness of vulnerable patients. Student tasks and activities were also important, including communicating with providers, interacting with patients during visits, making telephone calls for follow up, and conducting home visits. Although common strategies were identified across sites, the degree to which activities were performed by students in sites was variable since each 'modified' the program to fit their needs.

Facilitators and barriers to the program

Our data suggested six themes related to barriers, facilitators, and strategies to improve the implementation and maintenance of value-added clinical systems learning roles. Table 4 includes representative quotations for each of these themes. A total of 746 coding references was applied to the data in the analysis—the number and percentage of the total of coding references are also included below. A Key-Driver Diagram depicts outcomes, drivers, and potential solutions for each theme (Fig. 1), and Table 5 summarizes key features for successful implementation.

Educational value (n = 302, 40%)

Early exposure to patient care helped prepare students to recognize barriers impacting patient health, advance students' problem-solving skills and raise awareness of required time and resources to effectively resolve issues. Many students documented in the

Table 1 Clinical sites and programs included in student patient navigator program

Clinical site categories	Affiliation	Maintenance status of site		
		Continued	Modified[a]	Withdrawal
Outpatient primary care clinic				
Inner-city patient-centered medical home	A	X		
Inner-city patient-centered medical home	A	X		
Inner-city patient-centered medical home	A	X		
Internal medicine clinic	A	X		
Medicare shared savings program	A	X		
Walk-in patient-centered medical home	A	X		
Community outreach program	B	X		
Community outreach program	B			X
Family practice outreach program	B			X
High-risk patient outreach clinic	B			X
Specialty-based clinic				
Amyotrophic lateral sclerosis (ALS) clinic	A	X		
Breast cancer survivorship program	A	X		
Emergency department program	A		X	
Heart failure clinic	A	X		
HIV clinic	A	X		
Inflammatory bowel disease clinic	A			X
Pain management clinic	A		X	
Pediatric hematology	A			X
Pre-anesthesia clinic	A	X		
Renal dialysis clinic	A	X		
Stroke program	A	X		
Surgical weight loss program	A		X	
Human immunodeficiency virus (HIV) outreach clinic	B			X
Spine clinic	B		X	
Surgery program	B			X
Free/underserved clinic				
Clinic for underserved patients	C	X		
Clinic for underserved patients	C			X
Clinic for underserved patients	C	X		
Tuberculosis clinic	C	X		
Transitions program				
Acute care inpatient discharge program	A			X
Internal medicine discharge program	A		X	
Physical rehabilitation hospital transitions program	A		X	
Surgical-oncology transitions program	A			X
Inpatient stroke program	B			X
Psychiatric hospital discharge program	B		X	
Veterans' affairs transition program	B		X	

Affiliation designations: A primary medical school affiliation; B community-based hospital; C independent clinical program

[a]Modification criteria: significant change in process or student tasks; change in mentor; decrease/increase in student number at site

Table 2 Examples and descriptions of clinical sites in the student patient navigation program

Outpatient primary care clinic	Specialty-based clinic	Free/under-served clinic	Transitions program
Setting Rural family medicine clinic affiliated with the medical school *Description* The nurse case manager provided education to increase students' understanding of the patient population and community resources (i.e. insurance case studies, pillbox exercise). The mentor identified patients who had frequent readmissions, multiple missed appointments or chronic conditions. Students completed home visits, called patients, and communicated assessments to clinic teams. Student navigators supported the patients who needed additional emotional support and guidance, and located resources (i.e. a lower cost in-home hospital bed, cleaning services, etc.) to improve their patient's quality of life	*Setting* Multi-disciplinary amyotrophic lateral sclerosis clinic affiliated with the medical school *Description* The clinical team identified the need for following up with patients regarding recommendations listed in the patient's chart. Student navigators called patients to learn about their progress, and answer any questions the patient may have had for the team. Students talked to patients via videoconferencing or via telephone. Students shared important details from each encounter with their site mentor and other providers via documentation in the EHR. Students performed home visits as needed to assess the patient's home or if the clinic felt the patient needed additionally assessment or support	*Setting* Free clinic for the uninsured and homeless *Description* The free clinic recognized the need for additional patient education to improve outcomes. Many patients had challenges in understanding how to manage certain medical conditions or diseases. Students developed educational pamphlets in English and Spanish, which became readily available in the clinic for all patients. Students also assisted physicians with translation during visits, provided diabetic education and researched local resources	*Setting* Rehabilitation hospital affiliated with the medical school *Description* Facility leadership recognized a need for assessing patient's home safety prior to discharge as several patients had experienced falls and inability to remain safe once discharged home. The program's staff did not have available time to complete home safety assessments. They assigned the student navigators to meet the patients, develop a rapport and schedule a home visit prior to discharge. During home visits and using a standardized checklist, students identified needed resources, such as a shower chair or wheelchair ramp. Student shared their findings by documenting within the EHR. Following this assessment, students would assist with the team's action plan by identifying resources needed by the patient

EHR electronic health records

Table 3 Strategies and best practices for implementing systems roles in four different clinical sites and programs

Category	Core elements	Unique to site type
Student orientation and continuous education at the site	Overview of the site Meeting the interprofessional care team Receiving EHR training Reviewing policies/expectations	*Primary care* review challenging and completed cases; review article (related to case); complete pill box/insurance card exercises; telephone and motivational interview training *Underserved* review of patient history; research local resources; attend local community events *Transitions* participate in team discussions; review patient history and charts
Patient characteristics best suited for student roles	Having patients with: Several chronic conditions Multiple barriers Prescription challenges Transportation issues Frequent admissions/ED visits Frequent no-shows to appointments	*Primary care* patients with frequent "no shows" to appointments; isolated and/or elderly; limited social network; recent/new diagnosis Specialty-based patients preparing for surgery; patients with chronic pain or condition; patients receiving dialysis *Underserved* patients with no insurance; patients with limited access to resources *Transitions* patients recently discharged; patients with a life changing event
Patient selection methods[a]	Referrals from specialty providers Referrals from PCPs/case managers Hospital and insurance data Student questionnaires administered to patients to identify those in need	*Primary care* site assessment survey; insurance list of high utilizers; recently-discharged patient lists *Specialty-based* identified through follow-up assessment *Underserved* students identify during wellness visits *Transitions* care coordination identification through readmission data; discharge assessments revealing barriers
Student activities in systems roles	Arrive at site, check in with mentors Phone calls with patients Meet patient(s), perform assessment(s) Research available resources Provide emotional support to patients Perform medication review/reconciliation Perform home visits/safety assessments Review patient charts Assist with patient education Identify community resources for patients Explore team dynamics/relationships Communicate/debrief with site mentors Document interactions in EHR Physician shadowing (when downtime)	*Primary care* complete home visits to assess patient's living conditions and potential barriers; research available resources for identified patient needs; follow-up with patient to share resources *Specialty-based* work with provider in history-taking, physical examination; discuss patient's condition with team; meet with patient after the appointment to clarify questions; attend patient appointments, surgeries, physical therapy, etc.; research available resources for identified patient issue *Underserved* work with provider in history-taking, physical examination, etc.; perform wellness exams; provide education; create bilingual patient-education documents; perform medication review with patient; discuss patient's condition with team; communicate with site mentors *Transitions* work with provider in history-taking, physical examination, etc.; perform home visit to assess safety; discuss patient's condition with team; communicate with site mentors; location resources for patients prior to discharge

Table 3 (continued)

Category	Core elements	Unique to site type
Resources students could use	Transportation services (e.g. ride shares) Insurance access (e.g. exchanges) Local programs, community resources Health care team	*Transitions* resource guides and websites *Underserved* clinical questionnaires to assess patient needs and barriers

EHR electronic health records, *PCP* primary care physician

[a]Students worked with patients for variable length depending upon patient needs; generally, the duration of the relationship ranged between 1 week to 6 months

Table 4 Representative quotations for each theme relating to facilitators and barriers to implementation and sustaining a student patient navigator program

Themes	Representative quotations
Educational value	We may have prevented readmissions and medication side effects. But the value is education for the student. It was a good experience for them regarding patient barriers to care and having a better understanding of being empathetic to the barriers patients face, and being able to find resources and understand how to use team members to help the patient overcome those barriers [Mentor, 1:1 interview]
	This will be the only experience we have where we're in a clinic as students in our careers when we're not focused on disease or diagnosis and we're just focused on the patient. Thinking about that is somewhat profound [Student, focus-group interview]
	This experience was very helpful to me. I look at healthcare in a different light, and with each patient that comes in, I consider what things may prevent them from maintaining good health. Sometimes, it is easy to get lost in all the tests and labs. These patients don't have insurance, can't get to the doctor's office because they don't have a car, may not be able to afford that MRI, or may not fully understand why they need to have the MRI done. They may not understand how cocaine could exacerbate their COPD, or they can't read the label on their medications. These are all things I will keep in mind in my future clinical experiences [Student, focus-group interview]
	We learned alot about difficulties with communication between teams, and how information can be lost in the mix of paper and electronic records. We were exposed to different barriers to care that patients faced, such as lack of transportation, financial means, or simply desire to go see their primary care physicians. [Student, focus-group interview]
Value-added from student work	We had patients who really loved the students. A patient we decided to not have students with again asked—'Are the students coming back?' She looked forward to that meeting every week. We utilized [students] in our really complex cases—to have that touch point every week would help us work on other patients. [Students] were able to say—'This is what we found, this is what's going on, this is what needs to be done' [Mentor, 1:1 interview]
	It's one of those intangibles in that it improves patient satisfaction, which is very valuable. In the instance of the gentlemen with his medications, lack of a blood thinner could have had a catastrophic affect leading to an additional hospitalization, which could have had a tremendous dollar value. [Mentor, 1:1 interview]
	I identified the patients' needs and concerns and relayed this information to the physicians and nurses to determine potential solutions. I believe I was able to help dissipate some patients' anxieties regarding their healthcare by developing and maintaining a positive rapport. [Student, focus-group interview]
	As a patient navigator, I was another point of communication in addition to nurse manager. The patients sometimes would share information or stories they forgot to discuss or did not feel comfortable sharing with the nurse. I passed on the patients' concerns to the nurse manager and helped enhance communication to ensure his/her needs were adequately met. [Student, focus-group interview]

Table 4 (continued)

Themes	Representative quotations
Mentor time and site capacity	The biggest obstacle was being busy doing my job at the same time, not being 100% sure what my patient load was going to be that day, or if there was going to be good patients for them to see. Patients are here a few days and gone, and they're not generally long-term. [Mentor, 1:1 interview]
	The biggest barrier we have is lack of space. We didn't always know where to put students. Maybe there wasn't a computer available that day. There were some privacy issues. That was a big barrier [Mentor, 1:1 interview]
Student engagement	50% of [students] were disgruntled. One said to me, 'I'm not a social worker.' I said, 'Are your patients social workers? Your patients are asked to do what you've just been asked to do.' He goes, 'Oh, now I get it' [Mentor, 1:1 interview]
	This was not the majority. Several students would only go so far in terms of creative problem-solving because that's all they were willing to do. They couldn't provide a good explanation of why. They just simply said, 'We're not going to do it.' Some students were more resistant to problem-solve. If they couldn't find an answer quickly they weren't necessarily willing to dig more or think outside the box. [Mentor, 1:1 interview]
	I was expecting [students] to be more autonomous. It may have been personality. We had to push them to step outside of their comfort zone. Even something as simple as making phone calls, some were more autonomous. We had to nudge them a little bit. Once they did, they matured and learned. Everybody's different—some are outgoing, some are not. That's part of the learning process [Mentor, 1:1 interview]
	One thing I worry about is a few students had a negative attitude. When they went to their sites, they didn't feel like they were engaged in what was going on. An outcome I worry about is if we have some vocal negative students, how it is going to look upon the medical school and students? [I had] one conversation with a young man who was helping somebody to create an application at a social service agency. He did the bare minimum amount of work and never took it forward in terms of helping somebody with an application. And so somebody else needed to do something. He just laid it on this person's desk and never went back for follow-up. So you spent 6–8 weeks waiting for something to happen and you never followed-up on it? You never asked what you could do to facilitate it getting completed? The people at that site probably didn't think too highly of him. If some students aren't performing at the level they should be, could that bring a negative connotation to the program? [Mentor, 1:1 interview]
	This is a broad sweeping statement and I definitely don't mean to apply this to everyone. But I noticed some negative attitudes toward it and I don't know where they started at or where they came from. [If only] they looked at it like I'm going to make this the best learning experience that I can instead of I might not be able to intervene with every patient. If they looked at it like that instead of getting complacent they might have been able to do that. So I think the attitude and perception from the very beginning has to be positive and that's a really important part [Student, focus-group interview]
	I'm the type of person who will try to make the best of my situation and learn no matter what. I entered patient navigation with little expectation and an open mind so I feel I got a lot out of it. And I don't know how to train students to do that part. But when I heard people complain, I wondered if it was actually bad or if it was because they weren't opened to the experience. [Student, focus-group interview]

Table 4 (continued)

Themes	Representative quotations
Working relationship between school, site, and students	We're going into our third year. In the first year, we thought—'We'll build this as we go,' and it was fun. We were having students work with high-risk patients who require alot of time and energy. The first couple months were bumpy until we had a rhythm and figured out how they could help us. Some students were not sure how they could help patients. We needed to give them guidance. Once we got things rolling, it improved. Mid-year, we asked students for feedback on what worked well, what didn't, and how to improve the program. That was really great [Mentor, 1:1 interview]
	My partner and I didn't feel empowered in the beginning to say anything due to lack of autonomy. It was a huge barrier because we weren't really getting much out of it since we weren't doing much. But the realization that we could give feedback and suggestions took us down an improved avenue for a better experience [Student, focus-group interview]
Continuity	The schedule is the most handicapped part of the program. [Students] changed their days alot as things kept coming up. 'This [session] is scratched out. How are we getting your days in for this month if you can't come that day?' Their schedules are tight. If you can't come this day, you try to find another day. It was challenging [Mentor, 1:1 interview]
	They were here from 1 to 5 pm, which was not an opportune time to be there for the consult to see the patient. That timeframe while they were here in the rehab hospital [was] the time when patients are going to therapy and they're focused on their therapy, and they're exhausted. A lot of them didn't want to be interrupted. But some of them did. It was a difficult time for the students to actually develop a rapport because they were seeing them [briefly]. Additionally, the patient [could be] discharged to home before the students came back for a return visit. So we had to revamp and have the student make a follow-up phone call to see how it's going [Mentor, 1:1 interview]
	The set day and time that we had to go [was the biggest challenge]. I went every other Tuesday and you could only see so much of your patients those days. But I don't think there's a way I could have gone other times because of the schedule. It's hard when you have other things going on. I missed a lot about my patients because I was only there every other week [Student, focus-group interview]

electronic health record (EHR), allowing them to further develop informatics and information technology skills. Mentors and students believed these experiences could provide essential skills for future physicians.

Valuable experiences were described as those in which students were integrated into team processes and assigned independent tasks, such as home visits, follow-up telephone calls, identification of community-based resources, and assisting patients in overcoming barriers. While these positive perceptions tended to be facilitators of success and continued site participation, negative perceptions acted as a barrier. Students described experiences where they primarily shadowed providers, completed repetitive tasks, or had limited autonomy or engagement, which limited the perceived educational benefit.

Value added from student work (n = 177, 24%)

At many sites, students and mentors believed the students extended the work of the site and added value to patient care. Participants commented that students provided psycho-social support to patients, "lightened" [mentor] the workload of care teams, and provided a "fresh pair of eyes" [mentor]. They added value by identifying additional community resources, providing education, and addressing patient barriers. Table 3 provides activities performed by students. Mentors often felt invigorated after working with students, but this was not always the case. At sites where mostly shadowing occurred, neither students nor mentors found the program to be useful. Additionally, there was often a disconnect between student expectations of what they should be doing, and the work they actually performed. Some students expected to "save the lives of patients," but their work in educating patients or identification of community-based resources was often perceived as of little value.

Mentor time and site capacity (n = 128, 17%)

Mentor time and site capacity for student work were both facilitators and barriers to success. While students perceived mentors who worked with them as an educational benefit, several mentors believed one of the biggest barriers was that the program could become an "add-on" to daily work. Some mentors spent up to 4 h preparing for sessions, and also spent time during each session on patient selection and discussion of patient profiles with students. Clinical space and resources were also challenges, as mentors often had to locate empty desks or telephones for student use. Other factors, such as implementation of a new EHR, lack of staffing, funding, and structural changes of the location, affected the site's ability to maintain the program. Several sites withdrew due to anticipated implementation of a new EHR and increased workload expectation for mentors.

Student engagement (n = 60, 8%)

An influential factor in the program's success was student engagement, which varied significantly across and within sites. Fully-engaged students were able to proactively problem solve and assist patients and recognize the work they were performing as a learning opportunity. While engagement was viewed as a facilitator, modest student engagement was a barrier to success. The reasons for limited engagement were varied. Data indicated some students had difficulty understanding the applicability of the program to their future careers and felt underqualified for the role. Others needed encouragement or prompting to understand how to assist patients to overcome barriers. To improve the degree of engagement, students needed training at the site. Table 3 provides core elements of training that students needed to be successful, along with knowledge of essential resources for their roles. A primary reason several sites withdrew from the program was mentors' frustration and resultant increased workload when students demonstrated limited engagement or motivation to contribute to patient-centered activities.

Working relationship between school, site, and students (n = 51, 7%)

Logistically, the relationship between the school, sites, and students required ongoing communication, collaboration, and problem-solving for programmatic improvement. In

particular, the school and sites increasingly recognized the need for ongoing communication, collaboration, and sharing of ideas across sites related to best practices to ensure most-optimal conditions were created for learning and patient care. Through observation and participants' comments, many sites encountered challenges that needed to be addressed in the short term to achieve success. The need for a continuous improvement cycle to address and prevent issues was identified as critical. Mentors described monthly check-ins and yearly "retreats" by the school as vital to making improvements and important to building a network between mentors. Students described critical improvements at the school level, such as improving students' introduction to the program, setting up realistic expectations, and creating resources and guides. As such, program leadership sought student and mentor assistance to improve resources, guides, and student training. The program also relied on student and mentor feedback to continuously improve experiences.

Continuity (n = 28, 4%)

Continuity of navigation for students' work was an influential factor in the program's success. Even though students had specific bi-weekly afternoon sessions scheduled for patient navigation, it was not unusual for events such as examinations, holidays, or other class events to disrupt regular participation. This discontinuity was identified as a hindrance to team integration and opportunities to contribute to patients and clinics as a whole. However, several sites noted improved continuity of care when students followed up with patients outside of scheduled days.

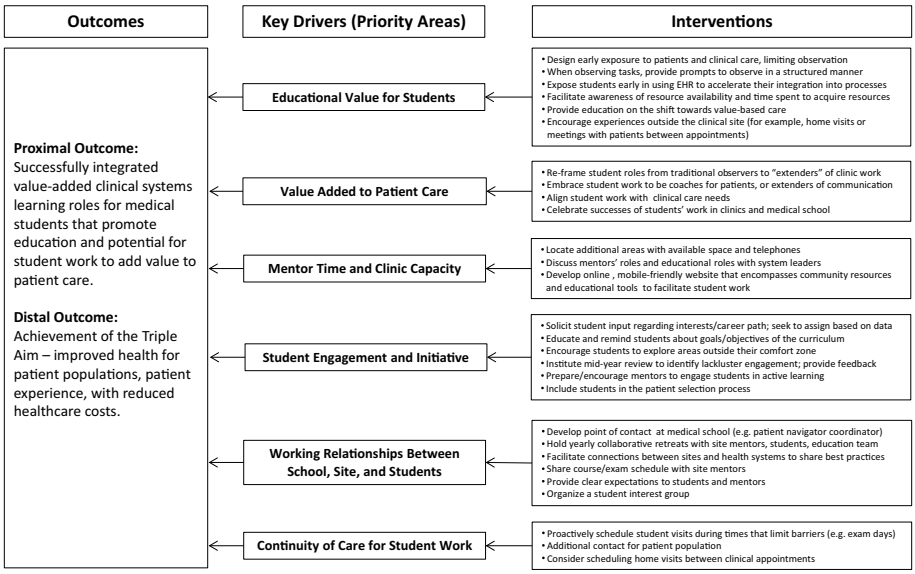

Fig. 1 Key-Driver diagram of outcomes, priority areas, and potential strategies for implementing value-added clinical systems learning roles for students in medical schools. The figure demonstrates the relationships between the outcomes (proximal and distal), "key driver" factors, and the potential interventions that could potentially influence the key drivers

Table 5 Top five key features for successful implementation of value-added clinical systems learning roles for medical students

1. Integrate students into interprofessional care teams to allow for interaction with work and processes
2. Ensure students are aware of site functionality and their role within team
3. Provide students the opportunity to be active, "value-added" participants in the clinical site rather than just observers
4. Provide students the opportunity to have a high degree of continuity within the clinical site and with patients
5. Develop a proactive continuous quality improvement process between curriculum, students, and mentors

Discussion

In this study, we identified facilitators and barriers to implementing and maintaining a program that integrates students into value-added clinical systems learning roles as they learn health systems science (HSS) competencies. After program implementation, 17 of 36 sites continued, 8 sites modified, and 11 withdrew from the program. The majority of sites that withdrew from the program were in other health systems or community-based hospitals rather than affiliated with our Academic Health Center. Using the Diffusion of Innovations lens allowed us to consider the facilitators and barriers that may have led to these results (Rogers 2003). In particular, we identified barriers such as limited student engagement, limited value added to care from student's perspective, mentor time and site capacity, underdeveloped resources of either the school or site to make continuous improvements, and continuity of experiences for students. Most importantly, we identified five key strategies for other health professional schools to consider when implementing similar programs (see Table 5): integrate students into interprofessional care teams to allow for authentic interaction, ensure students are aware of site functionality and their role within team, provide students the opportunity to add value to the clinical sites rather than observe, provide students opportunities for continuity with patients and providers at each site, and develop a proactive continuous quality improvement process between curriculum, students, and mentors. We believe this study provides a useful window into key factors necessary for medical schools to develop and sustain sites within and, in particular, outside of Academic Health Centers.

As care delivery and medical education undergo significant reform, medical students can learn about and contribute to health systems by participating in activities that add value (Lin et al. 2015). Our study suggests that value-added clinical systems roles have the potential to bridge classroom-based learning of HSS and clinical science with hands-on, patient-centered experiences in the setting of evolving care delivery and medical education reform (Gonzalo et al. 2017b; Lucey 2013). These roles are increasingly being described in the literature, but practical factors to consider during implementation and maintenance have not been well delineated (Curry 2014; Gonzalo et al. 2014, 2017c; Gonzalo 2017; Lin et al. 2015). We believe this study can guide other health professional schools developing similar programs with similar goals. This study defined practical aspects, such as site orientation and continued training for students, along with resources students need to be successful. It also identified patients best suited for student work.

An important finding in this study relates to the influential contribution of student engagement and initiative to sustain such a program. Student engagement has been

identified as a rate-limiting factor in educational innovations, particularly during a time when undergraduate medical education programs are rapidly transforming to prepare systems-ready physicians (Gonzalo et al. 2017; Irby 2011; Lucey 2013; Skochelak 2010). Historically, student characteristics that can predict student engagement and performance have revealed that those who perform better on preclinical science coursework tend to be "narrower in interests, less adaptable, less articulate, and less comfortable in personal relationships" (Gough 1978). More recently, recommendations have been made by the Association of American Medical Colleges to shift the principal emphasis for admissions away from undergraduate science preparation to a more holistic approach, including students' commitment to service, cultural sensitivity, and interpersonal skills (Witzburg and Sondheimer 2013). This historical context may, in part, provide insight into the variable degree of student engagement. Success in the patient navigator role depends on students taking an active role, applying interpersonal communication skills, and committing themselves to the patients and the care team, all in the face of curriculum-based priorities. Going forward, it remains to be seen if these challenges to student engagement can be successfully addressed. This includes attention to system issues, such as high-stakes board examinations that currently de-prioritize HSS competencies. Additionally, future studies should evaluate the consequences, good or bad, of placing students into value-added clinical systems learning roles early in medical school. These roles expose students to challenging systems issues early in their career that they would have previously only encountered in clerkships or residency training.

We propose that educational and clinical value go hand-in-hand, and medical schools and sites must work together to create experiences for students that achieve both goals. Our data suggest that there are strategies for enhancing educational value, including encouraging experiences outside of clinical sites, such as home visits, or ensuring students receive oral/written feedback throughout the program. In return, students must be able to provide value to sites (Gonzalo et al. 2017d). Interventions to foster student value include reframing student roles as "extenders" of clinic work and clinical care needs. To achieve this goal, medical schools need to create meaningful curricular space and priority for students to take advantage of opportunities for continuity with mentors and patients. Schools and sites need to collaborate on partnerships built on shared goals and objectives that can accommodate inevitable disruptions and changes while developing a shared investment in education and patient outcomes. We have identified some of the key drivers that need to inform these relationships.

This study has several limitations. First, services provided within sites were varied, and all sites were geographically located in south-central Pennsylvania, potentially limiting generalizability to other site types and regions. Second, while we purposely conducted focus-group interviews with students in each of four clinical site types, participating students were volunteers, raising the possibility of selection bias. Lastly, data used in this study were from the first 2 years of the program, and longer-term outcomes were not available. However, we believe these findings are an important starting point for understanding how to develop and implement such a program.

In conclusion, our results identified facilitators, barriers, strategies, and best practices for implementing and maintaining value-added clinical systems learning roles. We believe that understanding these elements is critical to sustaining a community-based program such as this. Factors relating to students, including their engagement and perceived educational benefits, and those relating to sites, including the value added to clinical care, acted as either facilitators or barriers depending on context. In addition, mentors identified barriers that affected their ability to provide effective oversight for students, including time,

students' schedules, clinical capacity, and space availability. We believe that value-added clinical systems learning roles will be key to addressing the challenge of educating systems-ready physicians in the 21st-century, and that data from studies like this one will be important for developing and sustaining effective programs.

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Compliance with ethical standards

Conflicts of interest Dr. Gonzalo is co-editor of a textbook on Health Systems Science (Elsevier, 2016). There are no other conflicts of interest to report.

Appendix 1: representative field site questions and prompts

Questions for medical students during visit:

1. What is your typical schedule?
    a. Arrival time/leave time
    b. Home visits, phone calls
2. How long do you work with patients?
3. Do you document in the EHR?
4. What did you learn during patient navigation?
5. Do you complete any additional activities during navigation days?
6. Do you have any suggestions on improvements in regards to navigation?

Questions for site mentors during visit:

1. Do you have any questions in regards to program expectations?
2. Should we provide any additional training or resources to the students?
    a. Resource lists, guidelines, etc.
3. What were the barriers you experienced in developing or implementing this program at your site?
    b. Schedule, engagement
4. How long did it take to orient the students?
5. How has patient navigation affected your work?

Appendix 2: student patient navigator focus-group interview guide

1. Implementation stage questions:

   a. What are your experiences so far with the student PN program?

      1. Probe: How would you describe your experience?
      2. Probe: (If they did not indicate any positive aspects), what was the most positive aspects of PN?
      3. Probe: What factors facilitated those positive aspects?
      4. Probe: (If they did not indicate any barriers or negative aspects), what were factors specific to your site that may have negatively impacted your learning as a PN?
      5. Probe: What are the features of the student patient navigator program in your site that make it successful?
      6. Probe: In thinking of your class as a whole—based on what you heard and your own experiences, what are barriers that may have negatively impacted the program as a whole?
      7. Probe: For those barriers that you described, how were these addressed?

   b. Tell me about expectations of your role.

      1. Probe: What were the expectations of you? Were they clear?
      2. Probe: What was a typical day/experience?

   c. What about the patients at your PN site?

      1. Probe: Which patients did you work with?

   d. Describe the mentoring at your site.

      1. Probe: Who were the mentors at your site?
      2. Probe: How did this mentoring relationship work best?
      3. Probe: How were the mentors influential to your experience in patient navigation?

   e. Think about things you needed to know to do your job as a patient navigator.

      1. Probe: Thinking about your few first experiences in patient navigation, what knowledge/skills do you think helped you navigate your patient?
      2. Probe: What kind of knowledge/skills would have facilitated even more?
      3. Probe: What resources did you use during your navigation experience?

      How did you access them?
      What resources would you have found useful?

      4. Probe: How long was the time frame for working with any one individual patient? What is optimal?

f. What barriers did you experience in the implementation of the patient navigation program?

2. Value From the Student Patient Navigator Program (to the site, to the stakeholders, to education)

   a. What value did you bring to your clinical site or program during the navigation program?

      1. Probe: How were you able to extend the work of the clinic?
      2. Probe: Tell me about how you helped to improve patient outcomes?
      3. Probe: Please describe the learning that occurred through the patient navigator program (either for the students, patients, or the clinic).
      4. Probe: If you were to put a value on the job you performed, how would you describe that value?

   b. Which patients in the clinic benefitted most from having a student assigned to them in the role of patient navigators?

      1. Probe: Which patients? Why do you think those patients benefitted?

3. Closing

   a. Please add any additional comments about the patient navigator program or the best practices that other programs should use to build their program.

Appendix 3: representative site mentor interview questions and guide

1. Implementation stage questions

   a. How would you describe your experiences so far with the student PN program?
   b. When you reflect on your implementation of the patient navigator program at your site, what were the barriers when you were implementing the program?

2. Maintenance stage

   a. Is your clinical site/program continuing in the student patient navigator program? What, if any, factors/issues were involved with the decision to continue or not continue the program?
   b. Are there any rewards or positive responses that have been realized through the program?
   c. Any negative outcomes from the program?
   d. Thinking about your original implementation of the PN program, I'm interested in how you have modified the program to work optimally at your site.

1. Probe: Were there tasks/activities that you anticipated students could do at the start of the program that they ended up not being able to?

a. If so, tell me about those tasks and reasons you think they were unable to do them.

ii. Probe: Likewise, were there tasks/activities students that you did not anticipate student being able to do that they could do? How did the students advance from the beginning of the year?

a. If so, tell me about those tasks and reasons you think they were unable to do them.

3. Value from the student patient navigator program (to the site, to the stakeholders, to education)

a. During an average session where medical students were serving in a patient navigator role in your clinic/program, how much time did it take to work with the students: _____

b. What value did the students bring to your clinical site or program during the navigation program, if any?

1. Probe: How did students extend the work of the clinic, if any?
2. Probe: How did they help to improve patient outcomes, if any?
3. Probe: If you were to put a value on the job performed by students, how would you describe that value?

a. Dollar value? Other value?

4. Probe: As you think about the patients in your clinic that were part of the student patient navigator program, what types of patients benefitted most from having a student assigned to them as a patient navigator? What challenges were these patients experiencing?

4. Closing

a. Do you have any advice or comments for us as we develop our program of systems-based practice for medical students?

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