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LONGITUDINAL INTEGRATED TRAINING IN RESIDENCY: A PARADIGM SHIFT TOWARDS STRUCTURAL SOLUTIONS FOR ACHIEVING KEY EDUCATIONAL COMPETENCIES

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LONGITUDINAL INTEGRATED TRAINING IN RESIDENCY: A PARADIGM SHIFT TOWARDS STRUCTURAL SOLUTIONS FOR ACHIEVING KEY EDUCATIONAL COMPETENCIES

Abstract

Graduate medical education typically organizes clinical training into discrete rotations. Longitudinal integrated clerkships, recently adopted by undergraduate medical educators, have been shown to achieve important educational outcomes for students including greater patient-centeredness, advocacy, and integration with teams. Despite the introduction of longitudinal, integrated clerkships into undergraduate medical education, this training structure has rarely been used in graduate medical education. This study explored residents' experiences and reflections on a longitudinal integrated block implemented in a large pediatric residency program.

Residents were purposively sampled to participate in an interview or focus group discussion after completing the longitudinal integrated block. Using a phenomenologic framework, a qualitative thematic analysis was performed to elucidate residents' attitudes about the block structure, how the block affected relationships, feedback, and learning, and whether the block influenced their professional identity or practice.

Fourteen residents participated in total, ten in interviews and four in the focus group. Six major themes emerged from the analysis: 1) the longitudinal structure enhanced relationships and entrustment; 2) the longitudinal, integrated design impacted engagement and learning; 3) flexibility promoted self-directed learning and work-life balance; 4) the block offered a unique time for professional identity development; 5) the block was an opportunity to reclaim patient-centeredness as a core value; and 6) there were both benefits and drawbacks to the schedule.

Longitudinal integrated blocks may offer an improved structure for achieving important yet challenging educational outcomes in residency, such as enhanced interpersonal relationships, meaningful feedback, entrustment, patient-centeredness, and systems-based practice.

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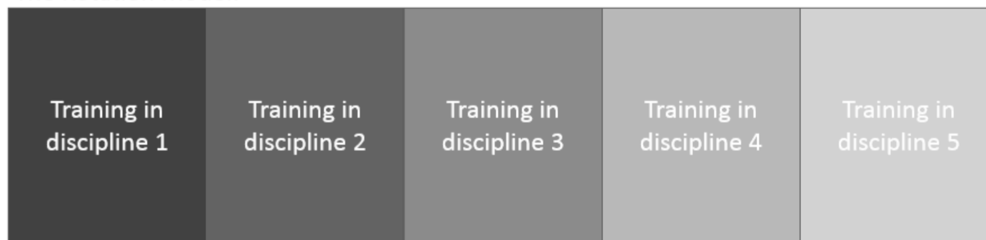
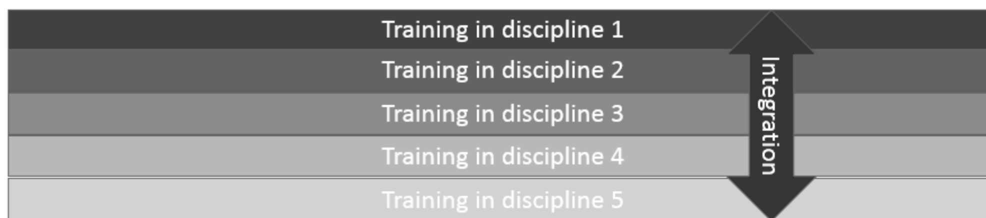
Chapter 1: Background

Undergraduate and graduate medical education have historically divided clinical training into discrete rotations.[1–3] In the rotational model, trainees experience specialty-specific rotations independently and sequentially over time (Figure 1). With increasing emphasis on competency-based education, leaders have challenged whether the rotational model optimally facilitates desired educational outcomes.[2–4] Brief rotations may not allow sufficient time for skill development, meaningful assessment and entrustment, or growth in domains like professionalism and system-based practice.[2,3] Frequent transitions between rotations can limit continuity, discourage ownership, foster maladaptive coping, and ultimately lead to suboptimal patient care and professional development.[2,4]

The Rotation Model:



Longitudinal Integrated Blocks:



Time

Figure 1: The Rotational Model vs. Longitudinal Integrated Blocks

As an alternative to the rotational model, numerous medical schools have implemented longitudinal, integrated clerkships (LICs) (Figure 1).[1,3,5,6] LICs combine multiple, previously discrete, specialty-specific rotations into a single training experience over many months duration. In these clerkships, learners experience different specialties concurrently and longitudinally, within a structure that maximizes patient and preceptor continuity and leverages learning science principles of relatedness, inter-

leaving, and spacing.[7,8] Research on students involved in LICs shows significant and sustained advantages in domains of patient-centeredness, advocacy, integration with teams, relationships with preceptors, and meaningful assessment over time compared with students on traditional rotations.[1,9–16]

Despite these reported benefits, few residency programs have implemented similar structural changes. While longitudinal experiences in residencies are common, longitudinal, integrated blocks (LIBs) remain uncommon. As Figure 2 illustrates, the few examples of LIBs in residency are shorter in length, integrate fewer subspecialties, must balance service and education requirements, and involve learners more advanced in their training and development compared to LICs. With these differences, whether LIBs lead to similar outcomes as those seen in medical schools is uncertain.

<table>
<tr><th></th><th>Differences</th><th>Commonalties</th></tr>
<tr><td>LIBs in medical school</td><td>• Learners are students
• Learners not integral to staffing
• Typically a full year
• Integrate 4-6 core disciplines
• Emphasize continuity with patients, preceptor, and inter-professional teams</td><td rowspan="2">• Longitudinal continuity is key
• Learners switch in a single day between different clinical settings (Monday morning is x, Monday afternoon is y)
• There is a predictable pattern to each week (Monday morning is always x, Tuesday morning is always z)
• Learners participate in the block with a cohort of peers</td></tr>
<tr><td>LIBs in residency</td><td>• Learners are residents
• Learners integral to staffing
• Typically a few months
• Integrate 1-3 disciplines that are logistically easier to merge (ambulatory, elective, research)
• Emphasize continuity with preceptor and inter-professional team; patient continuity harder to emphasize</td></tr>
</table>

Figure 2: Commonalities and differences between LIBs in medical school and residency

In 2013, the Boston Combined Residency Program (BCRP) implemented Keystone, an LIB that delivers longitudinal, integrated training for residents in advocacy, developmental-behavioral pediatrics (DBP), and emergency medicine. As Keystone is one of the first LIBs in residency, we undertook a qualitative study to better understand residents' experiences in the LIB. The specific aims of this study were to explore: (1) residents' attitudes regarding the overall structure and core characteristics of the block, (2) how the block impacted relationships, feedback, and learning, and (3) whether and how the block influenced residents' professional identity and practice.

Chapter 2: Data and Methods

Setting: The Keystone Quarter

The BCRP is a large pediatric residency program (150 residents) based at a freestanding children's hospital and urban safety net hospital in Boston. In 2013, the BCRP implemented an LIB for first year residents called Keystone.

Keystone is an ambulatory block in the intern year that combines 3 previously discrete 4-week rotations into a integrated 12-week training experience. At the time of this study, Keystone combined DBP, emergency medicine, and advocacy. The daily schedule was organized around half-day sessions. Each day consisted of a morning and an afternoon session, with occasional evening and weekend sessions. Half-day experiences included longitudinal DBP and primary care clinics, occurring consistently on the same day of the week with the same preceptors and inter-professional teams; an integrated seminar series on Monday and Friday mornings; as well as half days dedicated to the Emergency Department (ED), community-based activities, visits to community organizations, and time to develop an advocacy project (Figure 3). All first year residents participated in Keystone with 11-12 residents participating in the quarter at a time.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
AM	Seminar series	Longitudinal DBP Clinic	Independent Session	Advocacy Experience	Seminar series
PM	Longitudinal Primary Care Clinic	Shift in the Emergency Department	Second DBP Clinic	Early Intervention Visit	Shift in the Emergency Department

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
AM	Seminar series	Longitudinal DBP Clinic	Independent Session	Advocacy Experience	Seminar series
PM	Longitudinal Primary care Clinic	Advocacy Experience	School Visit	Shift in the Emergency Department	Shift in the Emergency Department

Figure 3: An example of a resident's schedule during two weeks in Keystone

Sampling and data collection

Our aim was to explore residents' attitudes about and experiences within Keystone in depth, as well as the meaning they attributed to those experiences. Thus, we chose phenomenology as our

methodological framework. A purposeful sampling strategy was used to recruit residents who had participated in Keystone during the 2014-2015 academic year.

Data collection was carried out in two phases. The first phase involved semi-structured interviews with residents, facilitated by a trained research assistant (KD) using an interview guide that was pre-tested for clarity and effectiveness (Appendix A). The facilitator had no role in the residency program, and participants received $20. Interviews were audiotaped and transcribed verbatim by the facilitator with distinguishable data de-identified. Data collection and analysis occurred concurrently so that the facilitator guide could be iteratively revised to explore emerging themes and to ensure data collection continued until thematic saturation was reached.

The second phase of data collection occurred 6 months later and involved one focus group discussion with residents. These residents had not participated in an interview, had completed Keystone at least 6 months prior, and had participated in Keystone during different quarters of the year. The focus group discussion was facilitated by the same research assistant (KD) using a pre-tested facilitator guide (Appendix B). Participants received $20 and a meal. The focus group was audiotaped and transcribed verbatim by the facilitator.

We chose the format of individual interviews followed by a focus group in order to capture participants' experiences in-depth but also capture variation between experiences and changes in their reflections over time after returning to traditional rotations. The Institutional Review Board of the Boston University School of Medicine approved this study.

Data analysis

Analysis of the transcribed data was inductive and followed a phenomenological approach. Members of the research team iteratively read transcripts as they were completed in order to immerse themselves in the text. From there, two members of the research team (CDM, KD) independently coded four interviews, building separate codebooks. Three members of the research team (CDM, KD, SR) then reviewed and combined these codebooks into a final codebook, reaching consensus through discussion about coding disagreements or when additional codes were needed.

Using the final codebook, two researchers (CDM, KD) separately coded the six remaining interviews and the focus group, with regular meetings during coding for clarification and checking. As a final step, a fourth member of the research team (DS) reviewed four of these coded transcripts in order to reconcile differences between the independent coders and ensure agreement with coding.

After coding, joint discussions between all five researchers facilitated the coalescence of codes into categories and themes. The entire team practiced reflexivity throughout and strived to analyze data in a purely inductive way. Reflexivity was maintained by using open ended questions, allowing participants to freely express opinions, involving multiple investigators, and welcoming differences of opinion. We used the qualitative analysis software Dedoose (2002) to conduct this study.

Results

Fourteen residents participated in the study: ten in interviews and four in the focus group. Interviews ranged from 35-61 minutes and were conducted 1-7 months after completion of Keystone. The focus group was one hour, took place 8-17 months after completion of Keystone, and was compromised of one resident from each quarter of the year. Characteristics of the participants are further described in Table 1.

Format	Sex	Quarter	MD/PhD	Post-residency plans
Interview	Female	1	No	Primary care, hospitalist
Interview	Female	1	No	Primary care, advocacy, policy
Interview	Female	1	No	Undecided
Interview	Male	2	Yes	Fellowship
Interview	Male	2	No	Fellowship
Interview	Female	3	No	Fellowship
Interview	Female	3	Yes	Fellowship
Interview	Female	3	No	Primary care, general pediatrics
Interview	Female	3	Yes	PICU
Interview	Female	3	No	ED fellowship
Focus Group	Female	1	No	Global health fellowship
	Female	2	No	NICU
	Male	3	No	Cardiology
	Female	4	No	Undecided

Table 1: Interview and focus group participants

In our analysis, six major themes emerged:

- Longitudinal structure enhances relationships and entrustment
- Longitudinal, integrated design impacts engagement and learning
- Flexibility promotes self-directed learning and work-life balance
- Unique time for professional identity development
- Reclaiming patient-centeredness as a core value
- Benefits and drawbacks to the schedule

These themes and representative quotes are described below. Additional quotes are in Table 2.

Longitudinal structure enhances relationships and entrustment

Because of the longitudinal structure of Keystone, relationships between faculty and inter-professional teams were more established, meaningful, and associated with higher quality learning and feedback than on traditional rotations. One impact of these longitudinal relationships was that residents' learning each week built more consistently upon what they had learned in prior weeks.

> [My preceptor] didn't have to keep explaining [the same concepts] to me. She knew what I knew and could say, 'We covered this concept last week, so let's talk about this [other concept] this week.' (Interview participant #8)

Residents also received more continuous feedback, which in turn led to preceptors entrusting them with greater patient care responsibilities over time.

> Because we had a relationship, [feedback] was more organic. One week [my preceptor] would say, 'You did that well, but you should work on this,' and the next week he would say, 'You are getting better at that, now try this.' (Interview participant #2)

> Trust is a huge advantage. It allowed me to progress from shadowing to quickly seeing patients on my own. This was possible because [my preceptor] got to know me and trusted me. In clinics where I showed up just once, people were not going to send me into see a patient because they didn't know me or trust me. (Interview participant #1)

The longitudinal nature of Keystone stimulated a greater sense of belonging among residents on inter-professional teams, a more nuanced understanding of team members' contributions, and an increased motivation to build relationships with teams.

> I belonged there. When I showed up to a clinic just once, I made less of an effort to get to know people and had less motivation to reach out. They were also less trusting in their interactions with me. (Interview participant #1)

Keystone enhanced relationships between peers participating in the block together, but could distance residents from their peers not in Keystone during the same quarter.

> It could feel isolating at times…I missed the camaraderie of [inpatient rotations] where you come in in the morning with the same group of residents every day (Interview participant #6)

Other disadvantages of the longitudinal structure included variability in the quality of preceptors and exposure to a narrower spectrum of patient pathology if preceptors specialized in certain diseases.

Longitudinal, integrated design impacts engagement and learning

The longitudinal structure of Keystone positively impacted residents' engagement in the learning environment as well as what they were able to learn.

> If I would have [done DBP] day after day, it would have been easier to check out than having it spaced the way it was. When you come in every Wednesday, you're fresh, and you pay more attention. (Interview participant #4)

> Having [experiences] spread over a longer period of time helped solidify the medicine in way that [doesn't happen when] things are bunched together. [Shorter rotations] go by quickly, but you don't get as much out of them because it takes awhile to catch up with your learning. (Interview participant #5)

Integrating subspecialties and experiencing them side-by-side also amplified learning by helping residents make more, as well as deeper, connections.

> You draw connections that you wouldn't draw otherwise because you are seeing [the subspecialties] in parallel. You are comparing and contrasting them all the time in your mind as you're balancing back and forth. (Interview participant #1)

> It keeps you on your toes, switching back and forth. It makes you internalize and learn things as opposed to falling into a routine, saying 'I got this,' and then leaving it behind. (Interview participant #4)

These connections led to improvements in the care residents could provide, especially related to advocacy.

> If I hadn't learned about [this resource] in [Keystone], I might have not thought to use it [for this patient]. To be honest, if I had learned about [the resource] during a short advocacy block earlier in the year, I may not have remembered. We learn about many resources in transient discussions. When it's not integrated, you just forget. (Interview participant #1)

Negative aspects of integration included resident apprehension that the lack of prolonged immersion in just one setting, because residents moved between different settings each week, stunted their learning curve, making it harder to become functional in new environments.

Flexibility promotes self-directed learning and work-life balance

Keystone provided flexibility for residents to accomplish tasks difficult to accomplish on traditional rotations. Tasks ranged from professional (meeting with potential mentors, engaging in research, exploring a subspecialty interest) to personal (getting a haircut, going to the doctor, spending time with family). This flexibility was facilitated by the self-directed time in the Keystone schedule.

> When you're at the hospital until 7pm, it's hard to meet with anyone. Not only finding the time to meet, but taking a step back to identify who you would even want to meet with. Having that independent [time] allowed us to do that. (Interview participant #1)

> You take care of yourself, exercise, and cook dinner. Unlike most days on inpatient services where you stay late, stay up late, [don't get] enough sleep. It's a stressful cycle. Keystone was a rejuvenating and healthy time for all of us. (Interview participant #3)

Beyond flexibility, residents used the longitudinal time to develop projects and, in one case, accomplish something they had never attempted before.

> Many kids come into the ED who felt warm at home, but their parents don't own a thermometer. We used to provide them, but don't anymore, and the cheapest ones are $12, which [can be] a lot. I looked into it, talked to people, applied for and received a grant to restock our primary care clinic with thermometers. It was exciting because I had never attempted to do anything like that before. The issue frustrated me, and I just fixed it. (Interview participant #10)

Some residents were frustrated by starting but not being able to complete projects, or having to contend with competing and disrupting priorities.

> I [wanted] two or three days to focus on [my project]. I would get inspired, start working, and then have an ED shift. You're pulled in a lot of directions. (Interview participant #6)

An important concept that emerged was the idea that 'You get out of Keystone what you put in'. With more self-directed time and less supervision than traditional rotations, residents needed initiative to use the time productively, and some were more successful than others.

Unique time for professional identity development

Keystone influenced residents' professional identity development because the block provided ample space to reflect on what it meant to be a physician, what their career goals were, and what their individual career path might look like.

Keystone pushed residents to think more broadly about systems and conceptualize their professional role within a larger context of health care, such as understanding the important role physicians play as advocates.

> Keystone colors our professional identity and enriches it in ways that wouldn't be true if not for Keystone…It flushes out our responsibilities to the community [that are] more than just clinical. It helps us understand [our] potential as advocates and the role we can play outside the walls of the hospital. (Interview participant #9)

Longitudinal preceptors often played important roles in this professional development, modeling what it meant to truly be the doctor, challenging residents to own, invest, and be responsible for patients.

Reclaiming patient-centeredness as a core value

Keystone was a time when residents reclaimed patient-centeredness as a core value. For some, Keystone sparked an urgency to start asking questions important for advocacy and quality care.

> The first thing you lose [on busy inpatient services] is understanding patients' needs and values. Keystone is a time to [reclaim] that. You have stories, where you [reflect] 'I could do that better.' For me it was that I never asked about immigration status. I thought…'[Shoot] I haven't been asking anyone about this.' (Interview participant #10)

The structure of Keystone, where residents moved frequently between different settings, accelerated their understanding of where patients came from and helped residents contextualize the social determinants of health.

> Keystone forces you to think about your patients in a context and [not just] within the four walls of a clinic room or hospital room. You have to recognize what they are dealing with outside of the hospital. You have to think more expansively and broadly about what's bringing them into the hospital. We will all be better practitioners because of [Keystone]. (Interview participant #9)

Benefits and drawbacks to the schedule

The Keystone schedule elicited mixed reactions from residents, though more positive than negative. For some, the variation in the schedule made it tough to establish a rhythm. The contrasting paces could be jarring, and some residents were surprised by how exhausted they felt.

> It was difficult to adapt. [During] the first weeks, I became progressively tired. Shifts in the ED could end late, and you might have something [in the] morning. Getting used to a non-standard schedule was important to getting through the day. (Interview participant #2)

Other residents enjoyed the shifting roles and settings, believing that the variety broke-up what might have otherwise been a monotonous traditional rotation. Additional aspects of the schedule residents

appreciated were fewer transitions to brand new services and having more time to gain comfort and confidence before moving onto the next rotation.

It was clear that the timing of the Keystone quarter within internship mattered. While some preferred diving into heavier clinical work earlier, others favored the foundational nature of Keystone and the benefits of having the block earlier.

> Starting on Keystone created a lens through which I saw [the rest of] residency. Looking at pediatrics through a developmental and advocacy focused lens…that's different than residents who started in the [step-down unit]. (Interview participant #1)

Although residents generally supported the idea of creating more LIBs in residency, especially in ambulatory specialties, they were concerned about the logistics and implications in inpatient settings.

> We should do more [LIBs]. They allow a perspective, integration, and multidisciplinary focus that strengthen our work. In the ICU, it would be hard [though]. You need continuity when patients are ill. But I think it could work for many blocks. (Interview participant #1)

Longitudinal structure influences relationships and entrustment	
Relationships take time to build	Building relationships takes time, no matter what. Even when you're on a month-long rotation, at the end you may know the staff, but it took a good part of that month to get to know them. Having a long-term schedule facilitates developing relationships in a powerful way. (Interview participant #1)
Education builds week-to-week	We developed a certain rapport. We could build on things. He wasn't constantly telling me the same things [over again]. (Interview participant #10)
Education builds week-to-week	I liked being with the same [preceptor]. At the beginning, it was shadowing, but then she let me do more [on my own]. When I was with a different preceptor every week, [we] had to re-build each time. (Focus group participant)
Inter-professional teams	[On other rotations], teams are piecemeal. Rarely do you get to pick the brains of other [inter-professionals]. The longitudinal clinics were different. I learned a lot because I had access to other disciplines so readily. (Interview participant #4)
Variable quality of precepted experience	[My DBP preceptor] was not in clinic every week. I never had someone I could latch onto. The weeks when he wasn't there, I would sit and watch behind the glass. (Interview participant #6)
Variable quality of precepted experience	My [DBP] clinic was very autism focused. I learned a lot about one specific area in development, but unfortunately [did not learn] as much about general [development]. (Focus group participant)
Longitudinal integrated structure amplifies engagement and learning	
Longitudinal design	I learned more from [my longitudinal] DBP clinic…having those memory circuits hammered over and over again. (Interview participant #5)

Spacing	While at times it felt like I was forgetting what I had learned the week before, overall [Keystone] helped me learn things better, to learn them over time, to constantly be revisiting and coming back to certain topics. (Interview #4)
Integration	By putting each [subspecialty] next to the other and juxtaposing them…it allowed us to synthesize more. (Interview participant #2)
Integration	If I do something once, it kind of sticks. If I do something a second time, it sticks more. Third time, etcetera. What happens is you end up seeing the same thing but through different lenses and solidifying your knowledge of that particular area. (Interview participant #7)
Advocacy integrated with clinical work	If I learned advocacy without a clinical context, it [would have been] tough to apply and [easy to] forget. Advocacy had such great context. You're in DBP seeing a kid that needs Early Intervention. You're learning about Early Intervention but also daycare funding. It's [content] that I would have forgotten if I hadn't seen patients it directly applied it to. (Interview participant #6)
Stunted learning curve	Having ED shifts spaced out created a difficult learning curve. Other trainees usually have a month and [at the end] really start to understand the flow. Whereas if you have a similar number of shifts but spaced out over time, your growth can be stunted. (Interview #9)
Flexibility promotes self-directed learning and work-life balance	
Self-directed time	Keystone is a wonderful opportunity to… explore the things you are interested in and take control of your own learning. (Interview participant #1)
Time to meet mentors	In other parts of the year, [my mentor and I] would try to meet and it was challenging. On Keystone, we could be creative about when we met. (Interview participant #7)
Time to meet mentors	One big advantage of Keystone is that [you] have more flexible time to meet and get to know mentors. I was able to meet [mentors] so that when I have elective time [next year], I'll have a place to start. (Interview participant #8)
Time to develop a project	[Keystone] served as a launching pad for me to find a project I could work on for the next three years. (Interview participant #1)
Time to develop a project	If you're working on a project, it's better to have [longitudinal time] than a 2-week stretch. If you reaching out to community organizations, they won't want to engage you for 14 days straight and never see you again. They want to hear from you a couple of times and have you move things forward on your own. (Interview participant #9)
You get out of Keystone what you put in	Make the most of [Keystone]. Make the most of your time. It depends on what your goals are. It would be easy to go home and watch TV every independent afternoon, but it's an honor system. (Interview participant #7)
You get out of Keystone what you put in	It takes initiative to maximally use the time productively, versus when you are on a structured inpatient rotation, you have to be there, and there's more supervision over the requirements. (Focus group participant)
Unique time for professional development	
Professional identity	I met people [with different] career trajectories. It opened my mind to things I could do. It got me interested in writing and journalism again. (Interview participant #6)
Professional identity	It's a great opportunity to think about where you are going career-wise. People started to identify more of what their professional identity would be. What it is to be a pediatrician and within that what your niche will be. (Interview participant #10)
Modeling what it really means to be the doctor	[We] saw the family of a 12 year old who was developmentally 2. Many families keep hoping it will get better. [My preceptor] had to sit them down and tell them, 'Your child is always going to be like a 2 year old. I'm sorry nobody has made that clear, but that's the truth, and we're here to help.' It was powerful. Having him tell

	me 'If you know the diagnosis and no one has told the family, then you should. Take ownership. Be honest with families.' I've utilized [that lesson] a lot since. With all the handoffs, it is easy to avoid ownership and say 'Someone else [can] share the results,' instead of saying 'No. I am the doctor. [I am] responsible.' (Interview #1)
Thinking about systems	[Keystone] encouraged us to think more broadly about systems. The charge to complete an advocacy project required [that we] take a more bird's eye view of a problem [we] wanted to change. (Interview participant #9)
Thinking about systems and quality	Understanding how the different benefit systems and the children's health programs work. Understanding where the gaps are and being exposed to people who work on these issues. Trying to understand that if you notice systems issues, how you bring those up, and find the right people to bring those up to. (Interview participant #2)
Physician as advocate	You always need to be an advocate. You really feel that in [Keystone]. You start to understand your role as a pediatrician. (Interview participant #10)
Reclaiming patient-centeredness	
Reclaiming patient centeredness	[Keystone] is a [time] to step back and look at how you deliver care. You have time to think about how you do things. Nobody wants to be the person who rushes through their job just to get it done. Keystone is a [time] to remind yourself of that. (Interview #6)
Where patients are coming from	We benefited from seeing different aspects of the hospitals we work at and communities we serve. Having to change gears accelerated our understanding of where patients are coming from. (Interview participant #9)
Scheduling challenges, advantages, and fatigue	
Disorienting	[The schedule] could be disorientating at times. You always have to refer to the schedule and ask 'Where am I going tomorrow?' It was hard to get a routine down. (Interview participant #10)
Exhausting	What surprised me is how tiring [Keystone] can be. Everyone says 'It's the best schedule you'll have all year,' which is potentially true. However, because [the schedule] is variable and because there are some long days, it [can be] exhausting. (Interview participant #1)
Welcomed variety	I welcomed the variety. Anytime you change modes a lot, it can feel jolting. One minute you are an ED doctor, another minute you're visiting a school, and then you're in clinic. But, overall, I welcomed the variety more than I was upset by the changes in pace. (Interview participant #9)
Getting into the groove	[Keystone] gives you time to get into something and not have it be over by the time you get into the groove. (Interview participant #1)
Getting into the groove	You don't change [rotations as often]. When you change [rotations in other parts of the year], there's some relief [because it is] something new. But then you think 'Oh geez, I'm picking up a whole new service.' (Interview participant #10)
Timing of the quarter	Particularly at the beginning of intern year, it can be hard to watch your co-interns who are not on Keystone doing [heavier] clinical rotations. You [worry] that you are going to fall behind. (Interview participant #4)

Table 2: Additional representative quotations

Chapter 3: Discussion and perspectives

Our findings highlight how an LIB in residency enhanced relationships, learning and engagement, self-directed learning, professional identity formation, and patient-centeredness. They also describe

residents' attitudes toward the schedule and expanding LIBs in residency. The themes that emerged offer new insights into how structural changes, such as LIBs, can alter the learning environment, educational experiences, and outcomes in residency.

Our findings highlight how the LIB enhanced relationships, learning and engagement, self-directed learning, professional identity formation, and patient-centeredness. The findings also importantly depict residents' attitudes toward the schedule and expanding LIBs in residency. The themes that emerged offer new insights into how structural changes, such as LIBs, can alter the learning environment, educational experiences, and outcomes in residency.

Benefits of Meaningful Relationships in the LIB

The impact residents reported Keystone had on their entrustment, investment in systems, and professional identity formation through development of meaningful relationships between faculty and inter-professional teams is noteworthy and builds on findings from LICs.[1,5,9,19] These longitudinal relationships were reported to have learning advantages as well. Precepted sessions began where prior sessions had left off, without the overlap or gaps residents' experienced on traditional rotations. The LIB structure allowed preceptors to keep residents at the leading edge of their zone of proximal development, helping them move more efficiently along an entrustment pathway. While these findings provide great promise, they also provide a call to action in modern graduate medical education where residents spend 2-4 weeks on a rotation and faculty are on service for just 1-2 weeks, leaving little time for building meaningful relationships or the efficient entrustment design afforded by LIBs. [20,21]

Deeper, More Self-Directed Learning

The integration across subspecialties on Keystone also had learning benefits for residents. Opportunities to apply learning, compare and contrast perspectives, and examine a problem through different lenses led to construction of knowledge in a way that felt more durable. This is consistent with educational theories of generative learning and interleaving.[22,23] Residents capitalized on the self-directed time in Keystone, accomplishing personal and professional goals, exploring individual interests, and developing their own approaches to self-regulated learning and work. This was exemplified by the

statement ‘you get out of Keystone what you put in'. As self-directed and self-regulated learning are keys to lifelong learning and improvement, our LIB’s downtime-by-design structure provided a way to authentically foster these values early in a career. Moreover, LIBs offer an exciting design for facilitating meaningful, longitudinal, individualized work alongside clinical responsibilities through most or nearly all of residency.[24]

Patient-Centeredness and Fostering the Humanistic Competencies

Empathy can erode during medical training, yet Keystone created a clinical learning environment where residents reported that they were able to reclaim patient-centeredness.[25,26] This mirrored findings from medical schools where students in LICs demonstrated greater patient-centeredness and empathy compared to students on traditional rotations, with differences persisting beyond 5 years.[15,27]

Also striking was how often residents mentioned the idea of physician as advocate in their reflections. This sentiment was shared by residents within and outside of our advocacy track and by MD/PhDs. Although one could attribute this attitudinal change to curricular content or rotation directors, residents believed this was a result of the Keystone structure and integrating advocacy with real clinical work. Professional organizations emphasize the importance of competencies like advocacy, patient-centeredness, systems-based practice, and practice-based learning and improvement.[28] Yet these competencies are difficult to teach and assess, feel haphazard when taught separately from clinical work, and may not ‘stick’ when taught in clinical environments where residents feel transient or less invested.[29–31] Our findings suggest that LIBs may represent a novel way of fostering these competencies in residency in more relevant and long-lasting ways.

Schedule and Expanding LIB

Although the schedule was stressful for some, most residents adapted within a few weeks, highlighting the need for orientation and support early in LIBs. The tension experienced between improved work-life balance and exhaustion from the non-standard schedule emphasizes the importance of choosing the right subspecialties for integration. The choice should be based on not only what is complementary from a learning perspective but also from a workflow and patient care perspective. While

residents supported the idea of building more LIBs in residency, they raised concerns about integrating rotations such as intensive care or wards. However, developing more longitudinal, non-integrated blocks for these subspecialties might achieve similar advantages.[17,18] For example, 8-10 week rotations, rather than 2-4 week rotations, might afford better opportunities for inter-professional team development and investment in systems while avoiding the frequent transitions away from services just as residents begin to feel comfortable, functional, acculturated, and connected.[4,19]

Limitations and Implications for Future Research

This study had several limitations. First, it was conducted at a single institution during one academic year. Residents were interviewed at various times after completing Keystone, which could have introduced recall bias, although we believe the delayed focus group allowed us to capture perspectives that crystallized after residents had moved back to traditional rotations. Two members of the research team were involved in designing and administering Keystone, which could have influenced analysis. We believe this was mitigated through engaging in reflexivity, memoing, triangulation with multiple layers of checking and independent coding, as well as collaborative analysis with other members of the research team not involved in Keystone who were able to offer alternative interpretations.

Future studies should focus on measuring higher-level learner, institutional, and patient outcomes in LIBs compared to traditional rotations, with choice of quantitative measures guided by the key themes that emerged here.

Conclusions

The findings in this study emphasize the need for *structural* innovations to achieve key priorities in graduate medical training including humanism, advocacy, and systems-based care. With leading educators calling for abandonment of the rotational model in residency training, the time for further experimentation and study of the LIB in graduate medical education is now.

Bibliography

1. Bell SK, Krupat E, Fazio SB, Roberts DH, Schwartzstein RM. Longitudinal pedagogy: a successful response to the fragmentation of the third-year medical student clerkship experience. *Acad. Med.* 2008;83(5):467-75. doi:10.1097/ACM.0b013e31816bdad5.
2. Holmboe E, Ginsburg S, Bernabeo E. The rotational approach to medical education: time to confront our assumptions? *Med. Educ.* 2011;45(1):69-80.
3. Hirsh DA, Ogur B, Thibault GE, Cox M. "Continuity" as an organizing principle for clinical education reform. *N. Engl. J. Med.* 2007;356(8):858-66. doi:10.1056/NEJMsb061660.
4. Bernabeo EC, Holtman MC, Ginsburg S, Rosenbaum JR, Holmboe ES. Lost in transition: the experience and impact of frequent changes in the inpatient learning environment. *Acad. Med.* 2011;86(5):591-598.
5. Hirsh DA, Holmboe ES, ten Cate O. Time to trust: longitudinal integrated clerkships and entrustable professional activities. *Acad. Med.* 2014;89(2):201-204.
6. Norris TE, Schaad DC, DeWitt D, Ogur B, Hunt DD, of Longitudinal Integrated Clerkships C. Longitudinal integrated clerkships for medical students: an innovation adopted by medical schools in Australia, Canada, South Africa, and the United States. *Acad. Med.* 2009;84(7):902-907.
7. Greenhill J, Walters L. AM last page: Longitudinal integrated clerkships. *Acad. Med.* 2014;89(3):526.
8. Greenhill J, Poncelet AN. Transformative learning through longitudinal integrated clerkships. *Med. Educ.* 2013;47(4):336-339.
9. Walters L, Greenhill J, Richards J, et al. Outcomes of longitudinal integrated clinical placements for students, clinicians and society. *Med. Educ.* 2012;46(11):1028-1041.
10. Myhre DL, Woloschuk W, Jackson W, McLaughlin K. Academic performance of longitudinal integrated clerkship versus rotation-based clerkship students: a matched-cohort study. *Acad. Med.* 2014;89(2):292-295.

11. Myhre DL, Woloschuk W, Pedersen JS. Exposure and attitudes toward interprofessional teams: a three-year prospective study of longitudinal integrated clerkship versus rotation-based clerkship students. *J. Interprof. Care* 2014;28(3):270-272.

12. Ogur B, Hirsh D. Learning through longitudinal patient care-narratives from the Harvard Medical School-Cambridge Integrated Clerkship. *Acad. Med.* 2009;84(7):844-50. doi:10.1097/ACM.0b013e3181a85793.

13. Ogur B, Hirsh D, Krupat E, Bor D. The Harvard Medical School-Cambridge integrated clerkship: an innovative model of clinical education. *Acad. Med.* 2007;82(4):397-404. doi:10.1097/ACM.0b013e31803338f0.

14. Konkin J, Suddards C. Creating stories to live by: caring and professional identity formation in a longitudinal integrated clerkship. *Adv. Health Sci. Educ. Theory Pract.* 2012;17(4):585-96. doi:10.1007/s10459-011-9335-y.

15. Gaufberg E, Hirsh D, Krupat E, et al. Into the future: patient-centredness endures in longitudinal integrated clerkship graduates. *Med. Educ.* 2014;48(6):572-82. doi:10.1111/medu.12413.

16. Hauer KE, O'Brien BC, Hansen L a, et al. More Is Better. *Acad. Med.* 2012;87(10):1389–1396. doi:10.1097/ACM.0b013e31826743c3.

17. Warm EJ, Schauer DP, Diers T, et al. The ambulatory long-block: an accreditation council for graduate medical education (ACGME) educational innovations project (EIP). *J. Gen. Intern. Med.* 2008;23(7):921-6. doi:10.1007/s11606-008-0588-y.

18. Warm EJ. Interval examination: the ambulatory long block. *J. Gen. Intern. Med.* 2010;25(7):750-2. doi:10.1007/s11606-010-1362-5.

19. Bonney A, Albert G, Hudson JN, Knight-Billington P. Factors affecting medical students' sense of belonging in a longitudinal integrated clerkship. *Aust. Fam. Physician* 2014;43(1):53-57.

20. Vygotsky LS. *Mind in Society: The Develompent of Higher Psychological Processes.* Cambridge, MA.: Harvard University Press; 1978.

21. Wood, D., Bruner, J., Ross G. The role of tutoring in problem solving. *J. Child Psychol. Child*

Psychiatry 1976;17:89-100.

22. Richland LE, Bjork R a, Finley JR, Linn MC. Linking Cognitive Science to Education : Generation and Interleaving Effects. *Methods* 1988:1850-1855.
23. Roediger, Henry L., Pyc MA. Inexpensive techniques to improve education: Applying cognitive psychology to enhance eduational practice. *J. Appl. Res. Mem. Cogn.* 2012;1(4):242-248.
24. The ACGME Program Requirements for Gradute Medical Education in Pediatrics. 2015.
25. Chen DC, Kirshenbaum DS, Yan J, Kirshenbaum E AR. Characterizing changes in student empathy throughout medical school. *Med. Teach.* 2012;34(4):305-311.
26. Avasarala SK, Whitehouse S DS. Internship and Empathy: Variations Across Time and Specialties. *South Med J* 2015;108(10):591-595.
27. Hirsh D, Gaufberg E, Ogur B, et al. Educational outcomes of the Harvard Medical School-Cambridge integrated clerkship: a way forward for medical education. *Acad. Med.* 2012;87(5):643-50. doi:10.1097/ACM.0b013e31824d9821.
28. Swing SR. The ACGME outcome project: retrospective and prospective. *Med. Teach.* 2007;29(7):648-654. doi:10.1080/01421590701392903.
29. Ackerman SL, Boscardin C, Karliner L, Handley MA, Cheng S, Gaither TW, Hagey J, Jennein L, Malik F, Shaw B, Trinidad N, Zahner G GR. The Action Research Program: Experiential Learning in Systems-Based Practice for First-Year Medical Students. *Teach. Learn. Med.* 2016;28(2):183-91.
30. Prober AS, Mehan WA Jr BH. Teaching the Healthcare Economics Milestone to Radiology Residents: Our Pilot Curriculum Experience. *Acad. Radiol.* 2016.
31. Varkey P, Karlapudi S, Rose S, Nelson R, Warner M. A systems approach for implementing practice-based learning and improvement and systems-based practice in graduate medical education. *Acad. Med.* 2009;84(3):335-339. doi:10.1097/ACM.0b013e31819731fb.

Appendices

Appendix A: Facilitator guide for resident interview

Thank you for speaking with me today and taking time out of your schedule to participate in this study. I am talking with you today in order to better understand your experience on Keystone. There are few residency programs in the country with longitudinal, integrated blocks like Keystone, and this study aims to describe the block in more detail. I am a research assistant working on the study and am not a part of the group overseeing Keystone. Everything said in this interview will be audiotaped and transcribed in a de-identified way so your opinions remain anonymous. The transcripts will be used to inform research as well as curriculum improvement. Do you have questions about the study or is there anything I can clarify?

1. To start, can you walk me through a typical day on Keystone?
2. On Keystone, residents' weeks were made up of different roles and responsibilities each day. What was it like for you to assume different roles and responsibilities each day?
3. Another aspect of Keystone is that residents learned multiple disciplines simultaneously. For example, a resident might learn something about DBP in the morning and then something about advocacy in the afternoon. What were the positive and negative impacts of learning multiple disciplines simultaneously?
4. I am interested in learning more about your Continuity DBP preceptor. Can you tell me what it was like to have a relationship with one attending for 12 weeks?
5. Did you develop other relationships with faculty while on Keystone, either as a part of the block or outside of the block, perhaps aligned with your own clinical or research interests?
6. Did the longitudinal nature of your Continuity DBP clinic impact your engagement in that clinic?
7. On Keystone, you were on one block for 12 weeks rather than 2 weeks or 4 weeks. What was challenging about the longer block?
8. What do you feel you accomplished during Keystone?
9. After Keystone, do you manage developmental issues such as speech delay, autism, or ADHD in primary care clinic differently?
10. After Keystone, do you screen for and manage issues related to social determinants of health in primary care clinic differently?

11. Did any element of Keystone surprise you?
12. What would you tell an incoming intern about Keystone?
13. What do you think about longitudinal, integrated blocks in residency?
14. We are nearly finished. The last three questions I will ask deal with definitions. For this interview, we have defined patient-centeredness as 'providing care that is respectful of and responsive to individual patients, their needs, and values and ensures that patients' needs and values guide clinical decision-making'. Do you think Keystone impacted the patient-centeredness of individuals in your class?
15. For this interview, we have defined professional identity formation as 'the gradual process by which young physicians assume the identity of the profession in their personal identity, role identity, and social identity'[1]. Do you think Keystone impacted the professional identity formation of individuals in your class?
16. For this interview, we have defined systems-based practice as 'understanding how patient care relates to the health care system as a whole and how to use the system to improve the quality of patient care'. Do you think Keystone impacted your class's awareness of and responsiveness to a larger context of health care?
17. Is there anything else you feel is important to tell me about Keystone?
18. Do you have any questions for me about the study?

I want to thank you very much for your time. I appreciate your thoughtful answers and reflection a great deal.

Appendix B: Facilitator guide for resident focus group

Thank you all for speaking with me today and taking time out of your schedules to participate in this study. I am talking with you today in order to better understand your experiences on Keystone. This summer we conducted individual interviews with residents asking them about their experiences on Keystone. This focus group is meant to follow-up on some of the themes that emerged from those interviews as well as explore new areas. I am a research assistant working on the study and am not a part of the group leading Keystone. Everything said in this interview will be audiotaped and then transcribed in a de-identified way so your opinions remain anonymous. The transcripts will be used to inform research as well as curriculum improvement. We very interested in hearing from everyone. Before we begin, does any one have questions about the study?

1. First, as you reflect back on Keystone, what stands out to you?
2. I am interested in understanding more about the relationships you developed on Keystone, particularly with your longitudinal DBP preceptor and your co-residents. Was there anything unique about the relationships you developed during the block?
3. Was your learning on Keystone different because of how Keystone was structured?
    a. If the learning was different, was that a good thing or a bad thing?
4. Do you think Keystone made you a different type of pediatrician in any way?
5. One theme that emerged from the resident interviews this summer was around the idea that Keystone was a time for residents to reclaim patient-centeredness. What are your thoughts on this?
    a. Has your perspective on this changed over time as you have gotten farther away from Keystone?
6. Another theme that emerged this summer was the idea that you get out of Keystone what you put in. What are your thoughts on this?
7. Everyone's experiences on Keystone vary. What do you think were the elements that varied the most between people's experiences?
8. Did the self-directed time during Keystone impact how you approached later parts of residency?
9. Is there anything else anyone would like to add about Keystone?
10. Does anyone have questions for me about the study?

I want to thank all of you again very much for your time. We appreciate your thoughtful answers and reflection a great deal.