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What Is Unique About Learning Health Systems?

Charles P. Friedman, PhD

My infatuation with Learning Health Systems (LHS) began in 2009, soon after the concept was first advanced by the organization then known as the Institute of Medicine, but now known as the National Academy of Medicine. The definition of an LHS offered in their 2012 report has been an inspirational guidepost for many:

> *A system in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the care process, patients and families as active participants in all elements, and new knowledge is captured as an integral by-product of the care experience. [1]*

In the ensuing years, as the concept matured and a substantial literature emerged, many definitions and elaborations have appeared [2-4]. This has inevitably led to uncertainty regarding what lies at the core of the LHS and also to a blurring of its boundaries: how the LHS differs from other approaches to health and health care improvement. Not surprisingly, I have been frequently asked: *What's new here? Isn't this the way to improve anything? How else would you do it?* This short essay offers some answers, grounded in a conception of what lies at the core of the LHS, that I would now give to these questions.

The differentiation begins with the concept of a learning or improvement cycle and the assertion that Learning Health Systems improve individual and population health by marrying discovery to implementation through cycles of the type illustrated in Figure 1 [5,6]. The cycle begins at "5 o'clock" with the establishment of a multi-stakeholder learning community. Guided by the community, the cycle proceeds with collection of data to capture what is happening now (performance to data), analysis of these data to generate evidence of how improvement might be effected (data to knowledge), integration of locally generated evidence

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with relevant evidence gathered by others, and intervention based on that evidence to engender improvement (knowledge to performance). From there, the cycle repeats in a series of iterations over which improvement occurs.

→ Insert Figure 1 about here.

There is nothing fundamentally new about cyclic improvement processes. This concept traces back to the seminal work of Deming and the subsequent widespread use of PDSA cycles in health care improvement [7]. The differentiators of the LHS--three in number, in my estimation—rest on how these cycles are executed and how a set of cycles composes into a scalable system. These differentiators also assume that the health problem addressed by the improvement cycle is a complex, even "wicked", problem that will prove resistant to unidimensional straightforward solutions.

The three differentiators are: 1) at the beginning of the cycle, establishing a multistakeholder learning community that is focused on the problem and collaboratively executes the entire cycle, 2) embracing at the outset the uncertainty of how to improve against the problem by undertaking a rigorous discovery process before any implementation takes place, and 3) supporting multiple co-occurring cycles with a sociotechnical infrastructure to create a learning *system*.

Continuity of Collaborative Execution

Members of a learning community are driven by a shared passion to improve against the health problem that brought them together. With reference to the left side of Figure 2, after a learning community forms into a cohesive group, that same group directs the cycle through the sequence of discovery (P2D and D2K), implementation (K2P), and back to discovery again as the cycle continues. Individuals with specialized expertise can enhance the execution of each phase of the cycle, augmenting the work of the persistent core membership of the community.

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→ Insert Figure 2 about here.

Continuity avoids the challenges of the "interrupted cycle" illustrated on the right side of Figure 2. Interrupted cycles occur when entirely different, specialized professional groups within an organization execute each component of the cycle. As shown in the figure, a group specializing in P2D might be focused exclusively on program evaluation or quality assessment; a group specializing in D2K might be focused on health services research; a group specializing the K2P might be exclusively focused on change implementation. The members of each of these relatively homogeneous groups will have similar educational backgrounds and professional cultures, but the backgrounds and cultures of each group may differ greatly from each other.

Interrupted cycles necessitate challenging handoffs between these different groups. Less than perfect communication between the groups can, for example, lead to different interpretations of the data at the handoff between P2D and D2K, and similarly, to different interpretations of the results of analyses as the handoff between D2K and K2P. Oftentimes, these elements report up to different senior leaders who may have different priorities. A cycle can stall if the group receiving the handoff believes the health problem has lower priority than the group initiating it. Moreover, the execution of an interrupted cycle may largely engage individuals who are domain agnostic methodologists lacking deep knowledge of and commitment to the health problem of interest. As such, they may lack the passion necessary to attack and solve a challenging health problem.

Embraced Uncertainty

Members of the multistakeholder learning community that drives a learning cycle begin their work from a position of uncertainty, acknowledging that the intervention(s) to achieve improvement later in the cycle are unknown to them at the outset. In the culture of learning systems, uncertainty is a virtue; premature certainty is a threat to success. The "performance to

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data" (P2D) and "data to knowledge" (D2K) components of the learning cycle comprise a process of discovery, not confirmation. Inevitably, members of the community will bring their own conjectures or hunches regarding the pathway to improvement. These hunches and conjectures must be held in abeyance until they are supported, or otherwise, by the data the community collects and analyzes. Premature closure on an intervention strategy, especially if driven by community members holding positions of authority or seniority, represents a threat to the success of a learning cycle.

This differentiation becomes clearer when one considers where the learning cycle starts. With reference to Figure 1, the initial iteration begins with formation of the learning community at "5 o'clock" on the cycle, so that the initial activities undertaken by a community are the discovery processes of P2D and D2K. It is also possible—but contrary to the fundamental premise of a Learning Health System--to start the cycle at "12 o'clock" with the implementation of an intervention purchased from a vendor, derived solely from the published literature with no local evidence, or mandated by senior leadership of an organization. Bypassing in this way the systematic empirical discovery aspects of the cycle (P2D and D2K) runs the risk of implementing an intervention that is not fitted to the problem as it exists in local context, or failing to discover a different strategy that might turn out to be superior.

Infrastructure Providing Shared Services

A learning *system* minimally requires two components. The first is a collection of simultaneously operating learning cycles of the type illustrated in Figure 1, with each cycle addressing a unique identified health problem and operating under the aegis of its own learning community. The second is an infrastructure that can be viewed as an integrated set of services supporting all of the simultaneous cycles, as shown in Figure 3. Figure 3 illustrates the multiple cycles supported by an annular platform. Arrayed along the platform are eight services that correspond to the stage of the cycle that each service primarily supports.

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→ Insert Figure 3 about here.

The infrastructure, if appropriately conceived and constructed, can support multiple co-occurring cycles because the cycles have similar structure. They share the sequence of first establishing a learning community and then proceeding through the stages of P2D, D2K, K2P, and back to P2D to begin the second iteration of the cycle. For example, methods to stand up and support learning communities [8], grounded in a literature on collaboration [9] are applicable to any health problem a cycle might be addressing. The services depicted in Figure 3 imply that the infrastructure supporting an LHS is socio-technical. These supporting services consist of policies, processes and people, in addition to technologies.

Lacking an infrastructure, a collection of cycles is just that. With an infrastructure, a collection of cycles becomes a learning system. The benefits of shared infrastructure are myriad. Infrastructure enables economies of scale. If each learning cycle is independent of the others and employs its own technologies, policies, processes and people, the cost of implementing N cycles will be nearly equal to (N x the cost of one cycle). An infrastructure providing shareable services, as depicted in Figure 3, will make the cost of N cycles much less than (N x the cost of one cycle). Infrastructure also enables economies of scope. Since the infrastructure provides services that are largely invariant with respect to the health problem being addressed by each cycle, support of additional cycles will require minimal modification to the infrastructure. Finally, infrastructure enables LHSs to "scale up". For example, a group of organizations with similarly architected infrastructures can, with relatively little effort, form a learning network that functions at a higher level of scale.

Conclusion

This brief essay has attempted to identify features that, taken together, characterize and distinguish Learning Health Systems. In the interest of clarity, I have framed as "all or nothing" a number of concepts that are, in reality, more graduated and nuanced. For example,

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infrastructural services cannot be completely agnostic to the health problems addressed by the learning cycles they are supporting. Moreover, in asserting that Learning Health Systems exhibit all three of these characteristics, I am not asserting that other approaches to health improvement exhibit none of them. Indeed, the work of quality departments at many health care delivery organizations may qualify as Learning Health Systems by the criteria offered here. In the end, what an entity does and achieves is far more important than what it is called.

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Figure Captions

Figure 1: The Learning Cycle Marrying Discovery to Implementation

Figure 2: Contrasting the Continuous Cycle Under the Aegis of a Persistent Community with an Interrupted Cycle Engaging Different Organizational Entities

Figure 3: Services Provided by an Infrastructure Supporting Multiple Co-Occurring Cycles

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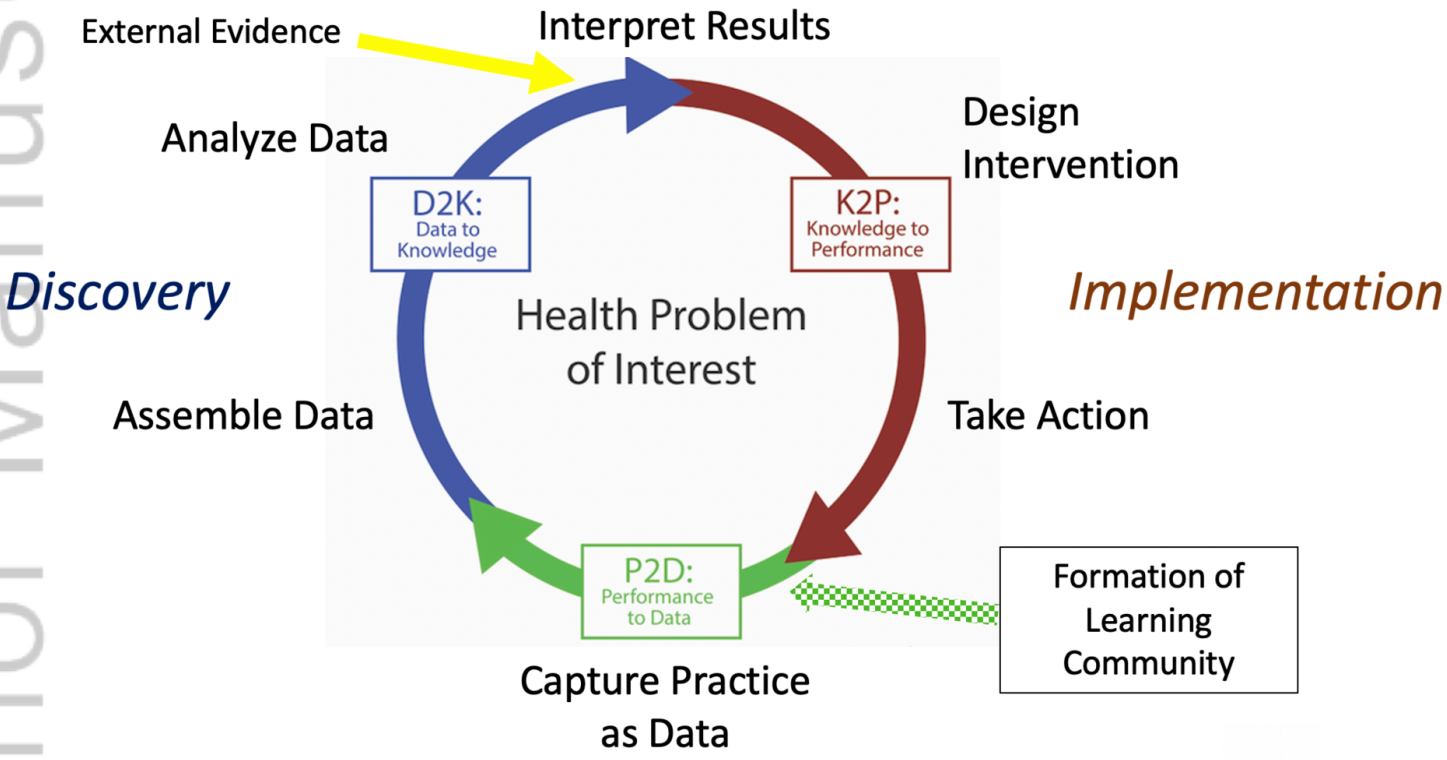

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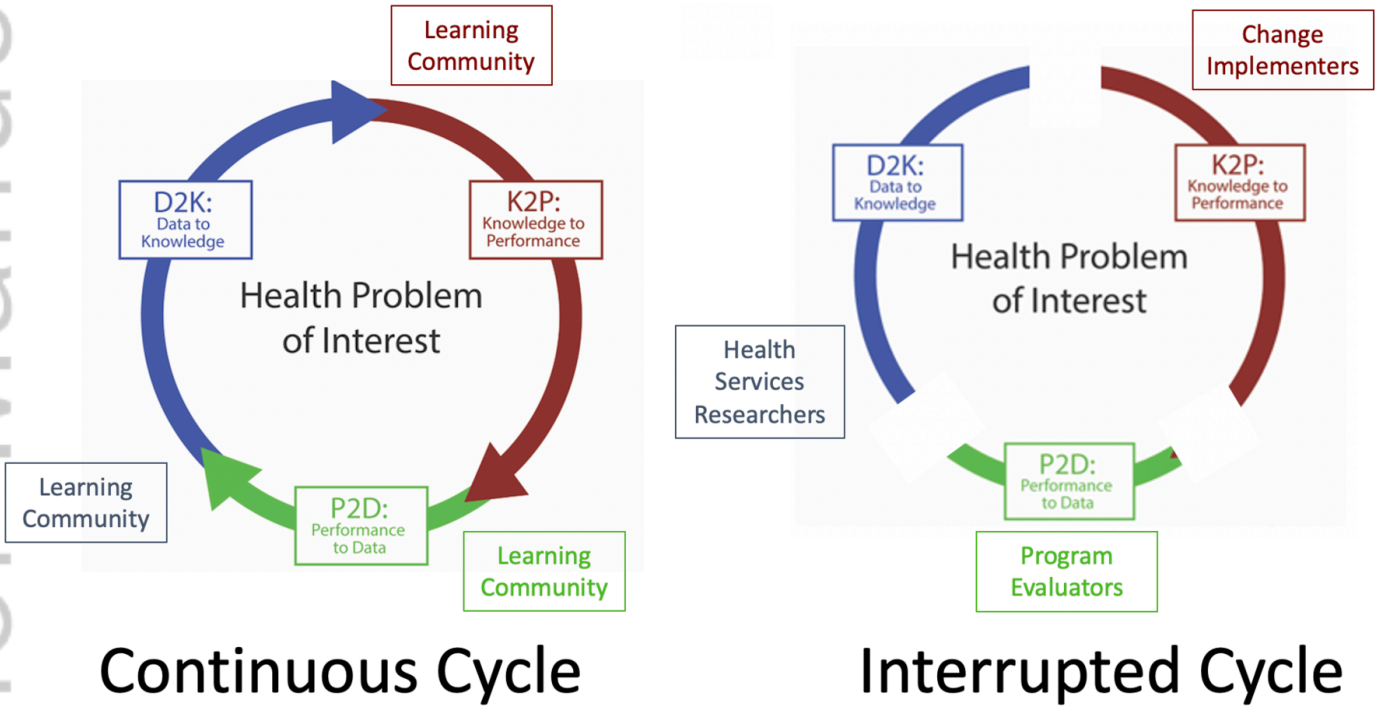

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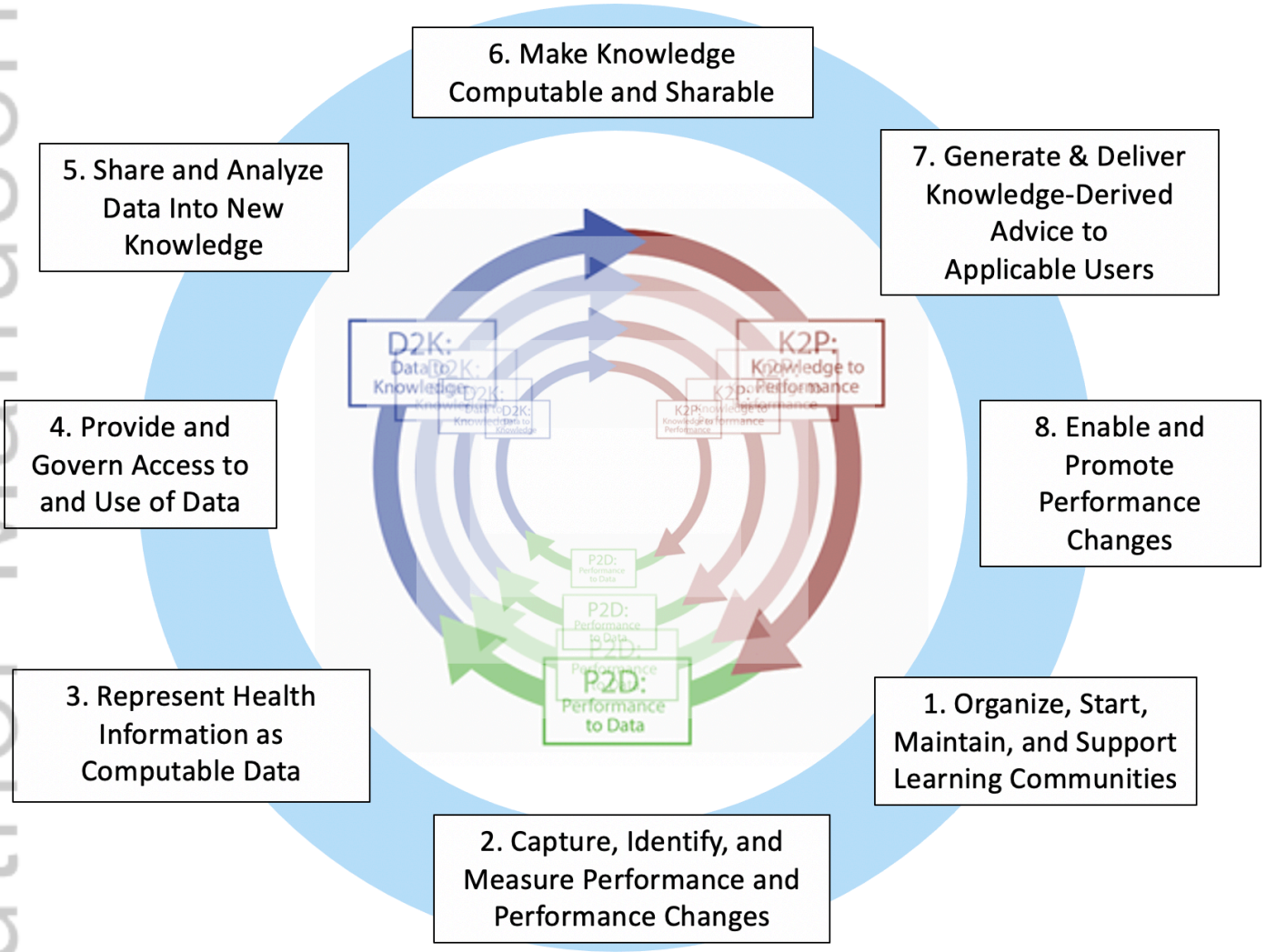

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