ESTEL Structure and Standards:
A Framework for the Learning Health Community

According to the Institute of Medicine of the National Academies (US), “A Learning Health System (LHS) is one in which progress in science, informatics, and care culture align to generate new knowledge as an ongoing, natural by-product of the care experience, and seamlessly refine and deliver best practices for continuous improvement in health and health care.”

Such a system can only be realized through coordinated collaborative efforts of a multitude of organizations and leaders who place global health improvements above individual self-interests. A Learning Health Summit in 2012 served as the launch for such an opportunity: The Learning Health Community. The mission of the Learning Health Community is to galvanize a grassroots movement in which multiple and diverse stakeholders work together to transform healthcare and health by collaboratively realizing the LHS vision. Those participating in the self-organizing efforts of the Learning Health Community are bonded together by their shared determination to realize the LHS and their common belief in the consensus LHS Core Values that serve to underpin it. (Journal of AHIMA, May 2014) The ten Core Values of the Learning Health Community are described at www.learninghealth.org. In summary, these values are:

- Person-Focused
- Privacy
- Inclusiveness
- Transparency
- Accessibility
- Adaptability
- Governance
- Cooperative and Participatory Leadership
- Scientific Integrity
- Value
**ESTEL as a Learning Health Community Initiative**

The actual work of the Learning Health Community is achieved through a set of initiatives, each directed at a key goal necessary to achieve a Learning Health System. Initiatives form around likeminded individuals willing to work together to achieve their objective. Each is hosted by a neutral convening organization. ESTEL (Essential Standards to Enable Learning), the first initiative of the Community, was launched in February 2013. The second initiative, focused on LHS Governance, was launched in October 2014.

The Purpose and Scope for the ESTEL Initiative was documented in an initial Charter: 

*“to define a parsimonious/essential/minimum core set of standards that could enable a standards-based yet flexible and scalable LHS in accordance with the following goals:*

a) *Ease the burden for any clinician to participate in a research study or other learning activity;*
b) *Increase the capacity for learning from data;*
c) *Obtain knowledge and results in an actionable form to contribute to building the LHS;*
d) *Ensure that the data obtained can be readily aggregated and/or compared; and*
e) *Ensure that the data uphold scientific integrity.***

A number of open ESTEL meetings and teleconferences, with broad and energetic participation, were held over a two-year period to explore the consensus-based establishment of a minimum essential set of standards that would need to be precisely specified to enable an LHS—along the lines of the Internet’s use of TCP/IP. Over the course of these discussions, it became clear that this approach should be preceded by another vital step: before minimum core standards could be identified, it was first necessary to identify an essential *structure* to enable learning.

The fundamental structure, what may be viewed as the backbone (‘double helix’?) of the LHS, is a *learning cycle or learning loop*. Below is a basic diagram that Dr. Friedman has presented to depict such a loop. To date, he has noted, more emphasis has been placed on the data collection arm (blue) and the feedback arm (red) is often slow, inadequate or missing entirely. However, the afferent and efferent arms are both very important and integral to the learning cycles that will enable a true LHS.
Learning health cycles are finite, determinate and automatable; they offer a manageable first step towards the broader LHS concept, which in contrast is infinite, indeterminate and emergent. Using the framework provided initially for such learning cycles can enable a trajectory towards standards required at each key point on the cycle. The ESTEL Learning Health Cycle Framework described in this document defines the critical role standards play in a comprehensive and scalable LHS, but it does not yet specify those precise standards.

This approach acknowledges that there are “islands” of learning occurring now around the world; however, these are typically on a relatively small scale; for example, within the boundaries of an institution, a circumscribed network of institutions, or across a given region. One challenge is how to scale and introduce connectivity and interoperability across these “islands”. Another challenge is to generalize the structure so that many more cycles can develop.

A Learning Health Cycle Framework captures shared structure and provides growth potential such that sub-systems comprised of multiple learning cycles can develop into larger systems. Standards and specifications are essential, but these may vary over time and across various diverse areas of interest or domains. They will emerge and evolve and eventually settle as we learn iteratively, continuously improving while maintaining flexibility to learn from real world evidence.

The **ESTEL Learning Health Cycle Framework** below was derived from prior depictions of LHS cycles into a proposed canonical format that can best serve the needs of the ESTEL project:
The ESTEL Learning Health Cycle Framework

The Learning Health Cycle Framework can serve as a tool leading to specifications of Essential Standards to Enable Learning. It can also become a standard in its own right. The Learning Health Cycle Framework:

a) defines what it means to be a player in this ecosystem;
b) provides a way to identify when a set of activities qualify as a Learning Health Cycle;
c) requires the articulation of key entities and key relationships among the entities;
d) requires efferent and afferent arms of the cycle with the proposed ‘cycle points’ shown in the final cycle depicted above;
e) creates a benchmark for identifying consensus-based standards to work in specific implementations for the domain of interest at each step of the loop;
f) will require that data accumulating at one step in a learning loop be semantically annotated to a sufficient degree to fulfill requirements for the next stage in the loop;
g) adheres to the Learning Health Community Core Values;
h) meets the ESTEL goals; and,
i) is scalable.

Criteria for ESTEL Standards

A good standard for a Learning Health Cycle meets the following criteria:

a) meets the purpose for intended use;
b) is not redundant to another standard;
c) developed through a robust, consensus-based standards development process, preferably by a global standards development organization;
d) mature and broadly used/adopted;
e) is open and freely available (not proprietary) and is protected by an IP policy to remain that way;
f) is maintained, with support, education and certification where applicable.

The ESTEL Learning Health Cycle Framework within a Learning Health System

Because a Learning Health System should support learning in a variety of domains and for numerous purposes, we expect that current implementations of learning systems will vary in their conformity or alignment to the basic framework for the Learning Health Cycle. A first step, therefore, is to understand this variation. There will likely be tension between the level of abstraction of the Learning Cycle Framework and instantiation of more precise essential structures and relevant standards for a particular learning cycle. Eventually, however, a
Learning Health System will consist of a set of information systems interoperating within a structure for the purpose of automating concentric and/or parallel Learning Cycles.

A Learning Health System should support all types of learning, including research, quality improvement, public health, outcomes and related activities. A Learning Health System should support BIG data initiatives for data mining, signal detection and safety surveillance. A Learning Health System should support the collection of high quality research data for Data Science highly specified data (e.g. for public health case studies) and streamlining research to accelerate the development of new therapies and reduce costs. A Learning Health System should support Data Sharing across various entities. A Learning Health System must engage patients, including the assimilation of patient reported outcomes and personal health information. A Learning Health System must support all of these opportunities while adhering to the ten aforementioned Core Values. The learning cycles that provide the framework for an LHS should conform to the LHS Values and the structural framework defined in this document, with enabling standards that meet the aforementioned criteria.

**ESTEL in 2015**

The ESTEL Initiative in 2015 will seek to identify ongoing learning efforts and map their structure against the Learning Health Community’s ESTEL Learning Loop Framework, including adherence to the LHC Core Values.

As we continue to learn, the Framework may need to be modified. ESTEL standards to support the LHS are expected to emerge, and it is hoped that the global health and healthcare will improve gradually but in a positive direction that benefits patients and/or keeps healthy individuals from becoming patients.

One Example of an ESTEL Learning Cycle that could support Research and Public Health (including available standards) is shown in the attached table.

Additional, specific examples are being sought. *Those interested in presenting an existing project or a proposal for a project, identifying touch points and how it might adhere to a Learning Cycle Framework are encouraged to contact one of the following individuals:*

Rebecca Kush (rkush@cdisc.org)

Landen Bain (lbain@cdisc.org)

Joshua Rubin (josh@joshcrubin.com)
## Attachment: Learning Health System – ESTEL Framework (Standards and Structure): One Illustrative Example for Research and Public Health

<table>
<thead>
<tr>
<th>Cycle Point (Structural Step)</th>
<th>Description of Activities between Points</th>
<th>Available Standards (for research, public health, outcomes)</th>
<th>Support for LHS Values, Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Experience</td>
<td>Clinicians or patients make observations and record them; recording can be in EHRs, Case Report Forms, eDiaries or ePRO tools, or devices. Questionnaires may be completed.</td>
<td>+CDISC Study Data Model (SDM) as a subset of the +Protocol Representation Model (PRM) +CDISC Clinical Data Acquisition Standards Harmonization (CDASH) +CDISC Therapeutic Area Specific Standards +CDISC Operational Data Model for transport +IHE’s Retrieve Protocol for Execution +IHE’s Retrieve Form for Data Capture (The last two are workflow standards for use of EHRs to support Quality, Research and Public Health.)</td>
<td>The standards named support: Data Integrity and Quality; Provenance Regulation 21CFR 11 FDA and EMA Guidance - eSource Complementary IHE standards exist for Security and Privacy Value in using standards from the start</td>
</tr>
<tr>
<td>Raw Data</td>
<td>The data are aggregated into a database, from which tables, listings and analysis datasets can be developed.</td>
<td>CDISC Study Data Tabulation Model (SDTM) and Analysis Dataset Model (ADaM)</td>
<td>Standards support requirements of FDA and PMDA (Japan)</td>
</tr>
<tr>
<td>Analytic Data</td>
<td>Determine the meaning and implications of the data (typically done by statisticians working with SMEs)</td>
<td>Standards support various sophisticated analytic tools.</td>
<td>Analysis Integrity needs to be ensure; standards support Traceability</td>
</tr>
<tr>
<td>Inference; Interpretation</td>
<td>Develop guidelines or guidance, results presentation or summaries of the learnings to be presented to clinicians and/or patients; comprehensible findings are presented in a format to be understood by the recipients.</td>
<td>ADaM (analysis datasets with interpretations/graphs) or summaries in layman’s terms.</td>
<td>Standards support Traceability Accuracy of reporting should be ensured.</td>
</tr>
</tbody>
</table>