The Lilypad System: Designing for Collaborative Reflection

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Introduction

Collaboration among healthcare teams requires integrating a patient’s data from different sources, reviewing changes in the data over time, and drawing from the knowledge of different practitioners to interpret these changes and make decisions. We call this data-driven process collaborative reflection. It enables decision-making over time based on what data reveals about the effects of interventions. Practitioners and patients also reflect on data individually, but ultimately this reflection is in support of the collaboration needed for a healthcare team to make decisions. Prior research has focused on supporting healthcare teams primarily by providing tools for structured work practices. In this work, we investigate the ad hoc, unstructured aspects of healthcare teamwork and address the need for tools that enable this type of work. We investigated collaborative reflection among teams providing mental and behavioral health services to children with special needs, as part of a special education program.

Collaborative Reflection

Our findings defined four characteristics of collaborative reflection: it is (1) unstructured, (2) mobile, (3) temporal, and (4) aimed at creating a shared understanding. First, in between protocols and structured activities there is a large amount of informal interaction, during which there is unstructured knowledge sharing that shapes decision-making. Second, there is a need for information technology that can support an understanding of information over time; help users identify and explain trends over time; and even help to predict behaviors or outcomes into the future. Third, informal interactions among collocated team members can happen anywhere, whether in a meeting or a hallway, so knowledge sharing is a part of mobility work. Fourth, the collaboration of collocated team members with interdependent expertise and a common goal involves creating a shared understanding of patient data.

The practitioners were reflecting on a patient’s data together by sharing their knowledge and understanding of that patient’s progress, in order to corroborate their interpretations and make decisions about how to adjust interventions for that patient going forward. Figure 1 illustrates the collaborative reflection process, which consists of two iterative loops.

The long-term outer loop shows four collaboration points over time, where team members have reciprocal interdependence. First, practitioners reflect on patient data to understand the needs of the patient and determine an appropriate intervention to move forward with. Second, multiple practitioners may be involved with an intervention, so reflecting on patient data can help practitioners apply the intervention consistently—for example by comparing patient responsiveness and immediate progress with different practitioners, or sharing successful strategies for applying the intervention and working with that patient. Third, practitioners evaluate the effects of an intervention by reflecting on the patient’s data over time. Fourth, practitioners disseminate information on the patient’s progress to others on the team, to practitioners not on the team, or to caregivers or family members.

The short-term inner loop shows how interdependent team members work together everyday to develop a shared understanding, which they draw on to make ongoing treatment decisions. Team members record data, reflect on the data both individually and collaboratively, and corroborate interpretations of the data with others.

Figure 1. The collaborative reflection process, consisting of a short-term inner loop and a long-term outer loop.
The Role of Information Technology

To support the iterative process of collaborative reflection, information technology can help team members collaborate everyday to develop a shared understanding, which they can draw on over time for decision-making.

• **Record.** Practitioners need a data collection system that is less cumbersome and time-consuming than paper-based data sheets. There is also an opportunity to improve consistency in data collection. Issues with consistency stem from data being collected separately by different practitioners, and efforts to maintain consistency are limited to staff training at beginning of the year followed by occasional reliability checks.

• **Reflect.** There is significant opportunity for improving visualizations of data to support both individual and collaborative reflection. Existing paper-based data management enables little more than scatterplots created by hand. However, the novelty of data visualization, analytics, and statistics for many practitioners makes the design and introduction of this functionality challenging.

• **Corroborate.** Practitioners often discuss data to corroborate their interpretations of what is going on with a patient. These discussions happen primarily during everyday informal interactions, when data may not be at hand—e.g., a conversation between two practitioners across the room while they are working with different children, or a discussion when two practitioners run into one another in the hallway. Corroboration could be improved by making data accessible in this type of context to support informal interactions.

We have developed a system to support collaborative reflection through a network of iPads used by members of a collocated team. We named this system Lilypad to convey the notion of independent points of interaction with data that also belong to an interconnected ecosystem for data management. In other words, a practitioner is aware that while she uses her Lilypad (or iPad) to record and reflect on her data, she also has the ability at her fingertips to connect with other practitioners to corroborate interpretations of that data and initiate discussion. Team members’ Lilypads are connected, and help them to be more connected for *ad hoc* collaboration.

The Lilypad system will be evaluated in a 3-month deployment study. We will use observation, interviews, and surveys to investigate whether the Lilypads help practitioners to reflect on data more both individually and collaboratively. We will look at impromptu interaction and scheduled meetings to see whether data use is different in these settings. System logs will also be used to understand which features are used most, when, and by whom.

Findings from our deployment of the Lilypad system will help us learn about supporting collaborative reflection in real healthcare settings. Our findings will inform future versions of our model of collaborative reflection, as well as refinements on how information technology can support this process.

**References**


![Image of the Lilypad system](image-url)

**Figure 2.** The Lilypad system is designed around three tabs, supporting record, reflect, and corroborate.