Time to reflect: Supporting health services over time by focusing on collaborative reflection

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ABSTRACT
When health services involve long-term treatment over months or years, providers have the ability, not present in acute emergency care, to collaboratively reflect on clients' changing health data and adjust interventions. In this paper, we discuss temporality as a factor in the design of health information technology. We define a temporal spectrum ranging from time-critical services that benefit from standardization to long-term services that require more flexibility. We provide empirical evidence from fieldwork that we performed in organizations providing long-term behavioral and mental health services for children. Our fieldwork in this context complements and provides contrasts to previous CSCW studies performed in time-critical hospital settings. Current literature shows a bias toward standardized records and routines in the implementation of health information technology, a policy that may not be appropriate for long-term health services. We discuss how the design of information systems should vary based on temporal factors.

Author Keywords
Health services; information systems; collaboration; reflection.

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Computer-supported cooperative work; J.3 Computer Applications: Life and Medical Sciences—Medical information systems.

INTRODUCTION

Health information technology (HIT) that collects, stores, and displays client health data and interventions can improve accuracy, efficiency, and collaboration in service delivery, resulting in better care. Historically, the design of HIT has emphasized standardization of both medical records and the practices that surround them, with a focus on tightly coordinated tasks, especially in emergency settings [3, 43]. The focus on standardization and inflexible coordination persists, despite mounting evidence from both research [12] and practice [20] of the limitations and unintended consequences of this approach. Diana Forsythe's pioneering work in medical sociology described the problem of over-standardization over 20 years ago, reasoning that HITs "are designed, built, and evaluated according to procedures that 'delete the social' and mute the voice of users" [10].

Forsythe's work and that of others suggests a need for taking a sociotechnical approach to the design and implementation of HIT, to take into account organizational factors, workflow, and social interactions in addition to technical factors [12, 26]. However, there remains a gap between methodological approaches and clear conceptual models of the role that HIT plays when it is not standardized. Recent reviews of the literature in 2010 [26] and 2013 [9] indicate that we still lack an understanding of how providers work together across health services settings in which standardization and tight coordination has not been implemented, and may not be either possible or useful.

In this work, we contribute to the move away from standardization by building on sociotechnical approaches, and toward concrete descriptions of new roles and functions of technology in health service delivery. With extensive fieldwork, we have defined a temporal spectrum (Figure 1) based on four pairs of characteristics derived from empirical data: structured or unstructured, sequential or iterative, predictable or unpredictable, and standardized or adaptive.

The ends of our spectrum represent two main categories of care: time-critical acute care and long-term chronic care. We have represented these categories as ends of a spectrum

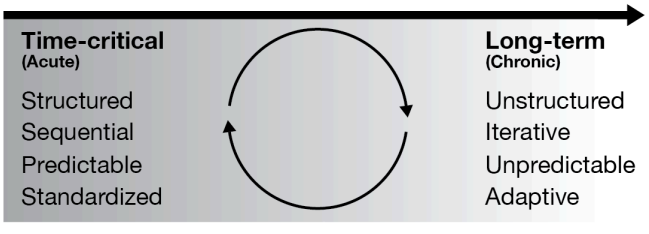

Figure 1. The temporal spectrum of health services we define in this paper, and use as a lens to discuss the design of HIT.

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to demonstrate a need for models of care that reflect a changing healthcare system that is becoming more complex and distributed across time. Figure 1 is an oversimplification of health service delivery, meant to emphasize how little we know about this spectrum and how much still needs to be filled in by future research. For example, diagnostic work falls somewhere in the center of the spectrum, as it may or may not be time-critical, and only certain symptoms elicit a sense of urgency. Diagnostic work is unpredictable in that the process and outcome cannot be known, but practices can be sequential and standardized.

Health services are likely to involve elements across the spectrum depicted in Figure 1, and also to fluctuate across points along the spectrum over time. A child on the autism spectrum generally requires long-term services to help him develop over time, but critical incidents are also common and require an urgent response to behaviors that are unsafe. Even the most structured and protocol-driven settings will have unexpected events that require flexibility, and even the most unpredictable environments will include some amount structure or protocol-driven responses.

The temporal spectrum in Figure 1 serves as a starting point for defining how practices that are motivated by different time scales should be supported. We focus on temporality as a motivator in healthcare work, complementing a typical focus on efficiency and accuracy, to understand the various ways in which temporality drives services. The leftmost part of the spectrum is well represented in the literature: health services in acute care tend to involve a large number of protocols for decision-making and standardized workflows. In this work, we begin to fill in the rest of the spectrum by understanding what happens when there is more time to reflect, to adapt services more to individual needs, and to remain flexible and malleable over time. To understand these types of services, we studied behavioral intervention for children with special needs.

This paper addresses the research question: How do we design HIT to support health services provided over time, when there is more time to reflect on data and less of an ability to standardize all practices? We explore how HIT might be designed to address different requirements and challenges than are required in time- and safety-critical clinical settings. For example, behavioral interventions such as cognitive behavioral therapy and smoking cessation programs take time and adjustments to produce results. Consequently, HIT should support these interventions by enabling flexible coordination and iterative decision-making among providers. The goals of this paper align with a recent theme in the CSCW community of slowing down, and thinking about temporality without assuming that the ultimate goals need relate to speed, efficiency, or formal structures [21, 25].

RELATED WORK

Much of the literature on collaboration in health services is drawn from studies in acute care contexts—especially hospital environments [1, 2, 5, 14, 26, 31, 32, 37]. Time- and safety-critical coordination has been studied in-depth in contexts such as trauma resuscitation [39] and emergency rooms [32]. In these high-risk environments, information sharing tends to be focused and fast, supporting mutual awareness and distributed cognition. When temporality is discussed, the focus is typically on time-critical aspects of health services [19, 37]. Few studies have investigated how health services are coordinated across time and organizations (*e.g.,* [13, 47]), especially non-clinical organizations (*e.g.,* [34]). These types of studies are needed for the CSCW community to form a holistic and ecological view of health services.

Collaborative reflection

In their review of 25 years of CSCW research in healthcare, Fitzpatrick and Ellingsen [9] identify key themes and contributions that show a focus on hospitals, standardization, electronic health records, and other structured aspects of services. Two themes of particular relevance to the present paper are (i) temporal coordination and (ii) expanding contexts of healthcare work – emerging but still limited areas of contribution. One of their concluding recommendations was a need to address new, integrated models of care:

> *"New models of care have emerged that look beyond the individual hospital or episodic encounter of healthcare. There is the notion of life-long patient-centric records that cross institutional and professional boundaries… There is also an increasing push of care into the home and the community, driven by the needs of chronic conditions, reflecting an integrated 'spectrum of care' model"* (p. 651)

The spectrum of temporality that we present in this paper scopes the variety of services needed from episodic encounter to life-long care, and what could lie in between. The complexity of health service delivery across time and place is a current theme in the HIT literature. For example, Marcu, Dey, and Kiesler use the term collaborative reflection to describe the processes observed in health service delivery that cannot be standardized [23]. Short-term activities comprise of recording data, interpreting data, and corroborating interpretations with others; these activities inform the long-term process of treating complex and unpredictable chronic conditions. The spectrum described in the present paper continues to consider the variety of activities and processes that need to be supported by HIT.

Harrison, Koppel, and Bar-Lev's review [12], using sociotechnical analysis, identifies common unintended consequences of HIT. These unintended consequences relate to the temporal spectrum that emerged from our empirical investigations:

- Structured: "Causing cognitive overload by overemphasizing structured and 'complete' information entry or retrieval." (Pine and Mazmanian [33] also report this problem.)
- Sequential: "Misrepresenting collective, interactive work as linear, clearcut, predictable workflow."
- Predictable: "Interface unsuitable for highly interruptive context."
- Standardized: "Misrepresenting communication as information transfer" (Mentis [26] also notes the need to represent and communicate more informal and subjective information.)

Working toward an alternative to these characteristics of HIT that are biased toward standardization, we draw from descriptions of work such as sensemaking, improvisation, and reflection.

Sensemaking, improvisation, and reflection

Theoretical constructs of collaboration have primarily been used to improve our understanding of time-critical and structured aspects of health services. For example, sensemaking is a concept often cited in CSCW literature. Weick's foundational work [46] described the enactment of sensemaking, or how the process of making sense of information plays out through the actions of individuals within an organization, including what happens when the process breaks down. Despite the wide-ranging applicability of sensemaking, in health service research, it has primarily been used to describe time-critical information seeking and coordination in contexts such as an emergency department and a surgical intensive care unit [32, 40].

Sensemaking-related concepts of improvisation and reflection have the potential to help us understand the less structured, predictable, and time-critical aspects of health services, however these theoretical perspective have not been used as much in this context. For example, Klein, Moon, and Hoffman's Data/Frame Theory is a macrocognitive model [18] that describes the iterative process of framing and interpreting data. Frames are used to "shape the data (for example, a house fire will be perceived differently by the homeowner, the firefighters, and the arson investigators)" and they also "change as we acquire data" (p. 1). Through a bidirectional process, frames "shape and define the relevant data, and data mandate that frames change in nontrivial ways" (p. 1). The frame metaphor captures unpredictability and a sensemaking process that unfolds over time.

Others have described unpredictability as improvisation, comparing it to the actions of skilled jazz musicians [27, 41]. During improvisation, skill and memory is applied to unexpected, non-routine events. Miner, Bassoff, and Moorman's field study showed how improvisation was embedded in organizational work over time [27, p. 327]. Their observations are similar to those made in other studies of sensemaking in organizations [2, 30], suggesting that flexibility is a quality that should be explored unfolding over time. When unpredictable events arise in the moment, the ability to respond and improvise appears to be an ability shared among members of an organization and embedded in their collective practices.

Much of organizational theory has focused on long-term processes, but the concepts of improvisation and reflection have distinguished these processes from those that are time-critical. Miner and colleagues [27] describe how short-term improvisation can "serve as a 'trial' in long-term trial-and-error learning" [27, p. 321]. Schön [41] describes reflection as the process that allows professionals to handle the "complexity, uncertainty, instability, uniqueness, and value conflicts" (p. 14) involved in domains like medicine, management, and engineering.

Organizational coupling

Karl Weick first described the advantages of loose coupling between people, tasks, and rewards, which enables organizations to adapt and survive under uncertain conditions [45]. O'Looney [29] discusses loosely coupled systems as sets of organizations working together for social service delivery. Our fieldwork focused on both the internal coordination of organizations, and their ability to coordinate externally with other organizations.

The organizations we focused on in our study were loosely coupled because providers needed to be flexible and adaptive in order to coordinate long-term treatment for each child. Characteristics of a loosely coupled organization include: a lack of rigidly defined roles and formal ties; collaboration that predominantly happens informally as needed to serve the needs of its clients; and events that are usually unpredictable [29, 45]. The traits that enable organizations to be adaptive and malleable in order to meet the needs of the people it serves are also traits that make technology generally unavailable or problematic for supporting these services. Marcu *et al*.'s [24] study of the persistence of paper-based records in special education provided empirical evidence of the challenges of incorporating technology in these types of organizations.

Harrison [11] extended the concept of organizational coupling to sociotechnical information systems, the practices and processes through which health service organizations coordinate and accomplish their work. He distinguished between mechanistic and organic sociotechnical systems. According to Harrison, mechanistic systems as more standardized, bureaucratic, and inflexible – traits that enable organizations to serve a higher number of patients with more efficiency and scalability. Organic systems tend to be more flexible, adaptive, and malleable over time – traits that enable more individualized services according to needs that may change over time. Harrison's concept of an organic system is similar to our discussion of HIT that is more flexible and can support unstructured, unpredictable types of coordination.

METHODS

The goal of this work is to complement field studies in time-critical clinical contexts, and improve our understanding of alternatives to standardization in the design of HIT. To this end, we conducted our fieldwork in a non-clinical context exemplifying unpredictability and a need for flexibility: behavioral and mental health services for children with special needs, provided within a school setting.

In prior work within the context of behavioral and mental heath services, we found an overreliance on paper-based records, and problems with adopting and incorporating HIT [24]. We were surprised by the use of paper records, despite their inadequacy for collaborative reflection [23]. The purpose of the present study was to further investigate this technology non-use and understand what aspects of these health services defied standardization and HIT adoption. Believing that HIT has failed to meet the unique needs of this setting, we set out to examine the process of collaborative reflection enacted in these health services, and relate our observations to the standardization of HIT.

Over the course of two years, we conducted 151 hours of fieldwork at seven organizations providing behavioral and mental health services for children with special needs. Six of the sites were schools (two with residential programs), and one was a therapy center providing after-school programs. While the organizations differed somewhat, their behavioral and mental health services were similar.

We observed clinical services that were integrated with educational services to address behavioral, emotional, and mental health needs. We observed and interviewed treatment teams providing these services, which were comprised of psychiatrists, mental health therapists, behavioral specialists, personal aides, and clinical supervisors. We primarily interviewed behavioral specialists, teaching staff, and aides, whose roles were central to coordination of services. Children had diagnoses such as attention deficit hyperactivity disorder, autism spectrum disorders, trauma, oppositional defiant disorder, and anxiety disorder. The organizations we studied provided treatment in the form of behavioral intervention, frequent positive reinforcement, cognitive behavioral therapy, and psychiatric medications. In our fieldwork we focused on the coordination of these services among members of the treatment team, according to the individual needs of each child.

We collected data through naturalistic observation in classroom, hallway, and conference room settings that encapsulated both formal and informal interactions [8, 22]. We conducted contextual inquiry [4] with the providers to understand their practices and collaborative workflow. We conducted 129 semi-structured interviews and focus groups with providers to collect data on their opinions and attitudes toward their use of HIT. We visited sites at least once a week, sometimes several times a week. During fieldwork we took detailed notes, and the research team met after fieldwork sessions to discuss and interpret the data. We used an iterative process to discuss themes while continuing to gather field data. The research team met several times a week to analyze and compare fieldwork data.

Our approach to collecting and analyzing field data was based on constructivist grounded theory [6]. We focused on gathering rich data using theoretical sampling across team members and contexts, constant comparison with data previously collected, and inductive thematic analysis. We analyzed data by comparing our findings to the literature, and came to interpret our findings using organizational theory. Emergent themes in our data led us to connect our findings to literature on organizational coupling and organic sociotechnical systems, which we use to present our findings in the following section.

FINDINGS

In this section, we describe the empirical data that formed the basis for our temporal spectrum of health services in Figure 1. The process of collaborative reflection that we observed was unstructured, iterative, unpredictable, and adaptive. Practices were unstructured because the individual and subjective nature of behaviors being monitored made data management difficult to standardize. Practices were iterative because monitoring and interpreting progress with behavioral interventions was complex. Practices were unpredictable because behaviors were ever-changing. Practices were adaptive because services were designed to respond to the unique behavioral needs and progress of each individual.

Unstructured

The nature of special education services defies standardization but treatments and progress have to be monitored. Due to the myriad of relevant data, efforts have been made to find ways to standardize data monitoring. We witnessed this challenge when we observed some schools attempting to standardized school-wide data monitoring. All students in these schools were asked to follow rules, such as “be safe,” “use kind words,” “complete work,” and “follow directions.” These rules were the basis of shaping behavior, giving positive behavioral reinforcement, and recording behaviors in a standard way. For example, providers would respond to violence toward a peer or property destruction by reminding a student to be safe, physically and verbally intervening, and then recording the incident on a paper data sheet. One goal of these records was to help treatment teams reflect on cases collaboratively and make sense of a child’s behaviors.

Despite the apparent structure of this approach, records varied widely. A record of an incident might be as simple as adding to a running tally of the number of times a behavior had occurred that day, or it might include details such as the duration of the behavior, names of peers involved, or an antecedent event, which could provide insight into the psychological trigger of the behavior. The amount of detail

in a record varied across providers, based on their workload and personal work style, and encouraged by virtue of the subjective nature of the data. Providers resisted standardization of both records and some of the practices surrounding them because it would interfere with individualized and adaptive services. However, a tradeoff was inconsistency from one child's data to another—which especially affected those team members with larger caseloads, such as psychiatrists and clinical supervisors. Schools used training and inter-rater reliability checks to maintain data reliability as much as possible, but data fidelity remained a challenge.

The process of collaborative reflection was also unstructured, and the record system was not flexible enough to support it. Due to the challenges with keeping records that are flexible enough for this process, reflection was often not driven by data. For example, during a progress review meeting we observed, a therapist asked a provider working exclusively in that child's classroom about the frequency of a newly exhibited behavior. In response, the provider made a guess that the behavior was lowering in frequency based on his intuition and the amount of pen ink taking up one of his data sheets. In another meeting, we observed a different provider making up an estimate because she also did not have detailed enough data to produce an accurate frequency: "I would say maybe 5% of those points happened out of the room [when the child was in the hallway or outdoors]". The data did not provide an adequate measure to be used for reflection, because data sheets were not flexible enough to be adapted to the individual and changing behaviors of each child.

Iterative

Sometimes, we observed that data was accurate but still not useful for reflection because it was not adaptive to changing needs in an iterative process. That is, data sheets were not easily adapted or updated as new measures needed to be used to address a child's needs. We observed one review meeting in which a record keeper, therapist, and psychiatrist were discussing a child's progress and struggling to use the data for collaborative reflection. The therapist concluded that "the data may be accurate but it's not reflecting how he's really doing". The data that they needed in that moment during the child's long-term development was not available due to the difficulty of keeping up-to-date records during an ever-changing and unpredictable treatment process.

Coordination of services was an ongoing and iterative process in the special education environment. Behavioral intervention in special education was an inductive process of continuously monitoring behaviors, interpreting data to understand progress, and iteratively adjusting interventions based on observed trends. A large number of stakeholders coordinated on a daily basis around the data as part of an iterative process of determining, applying, and evaluating interventions. Because providers spent the majority of their time working directly with the children, leaving little time for formal coordination, their coordination was embedded in everyday practices.

To give children the resources and support they needed, providers with different expertise compared their observations and interpretations regularly. On a typical day, a teacher, teaching aide, speech therapist, occupational therapist, psychiatrist, and supervisor might all have discussed one child's data together or in smaller groupings. For example, a clinical specialist such as a speech therapist or psychiatrist was depended upon for clinical expertise, but an education paraprofessional such as a teaching aide worked with the child on a daily basis and had the most intimate understanding of that child's progress. Both types of stakeholders contributed their personal knowledge to managing a child's case.

During this iterative process, records were not easily adapted or updated, resulting in continuously increasing work for record keepers. One record keeper recounted a conversation with his supervisor during which he was once again asked to record more data without additional support. Having tried different ways to ask for support, he suggested to his supervisor: "we should do time studies to figure out how long all of these recording activities will take." The supervisor rejected the idea, saying, "this isn't a factory." The record keeper's reaction was "yes, it is"—revealing his disappointment that the demands of record keeping were interfering with his direct work with children. This record keeper often shared his feelings with us, typically using sarcastic humor to express his frustration with supervisors' unrealistic expectation that he manage both "clerical work" and providing behavioral interventions for multiple children: "they're turning this into an office job—inside a petting zoo!" These tensions that we observed related to the unequal burden of data management revealed that the organizational culture was democratic and meant to be empowering but a lack of adequate HIT meant that data management practices contradicted those cultural values.

Supervisors also tended to have unrealistic expectations that an incident be recorded in the moment or immediately thereafter. The accuracy and timeliness of a record depended on the provider's availability to create the record, and they were often busy with tasks of higher priority such as working directly with a child. The gap between what was expected and what was possible was a significant issue during HIT design work—some supervisors were unaware of this gap, and all of them were unsure of how to address it. We saw frustration among the record keepers expected to create and manage records without adequate support or tools, and their frustration grew with each passing month.

Unpredictable

The provider-to-child ratio in the settings we observed was high due to the need for close supervision and frequent behavioral reinforcement. Children's ever-present and changing needs and behaviors required providers to support

one another and jump in to fulfill responsibilities. Regardless of whether providers held roles such as teacher, therapist, or supervisor, to ensure the safety and wellbeing of children and providers alike, all providers were trained to respond to behavioral incidents, and did so at a moment's notice when the need arose. For example, when a child grew frustrated and left the classroom, at least one provider would follow him into the hallway (or outside) to ensure his safety, talk him through managing his emotions, and generally wait him out until he was able to calm down and move on. This intervention might take minutes or hours. Meanwhile, the remaining providers in the classroom needed to continue the current activity with the rest of the children, and ensure that record keeping continued. A provider from outside the classroom, such as a therapist or supervisor, sometimes filled in if additional support was needed. As such episodes were unpredictable and could accumulate across multiple children at any given moment without warning, providers were always ready to share responsibility at a moment's notice.

Providers manually recorded data throughout a school day, and did not use specific, uniform rubrics or codes. People, locations, activities, and types of data sheets changed many times throughout one day. Different people collected data in different situations. These sources of variance increased the complexity of using data for coordination. The various stakeholders who collected and used the data were dependent on one another because they each only knew part of the story – *i.e.*, they were present for different events, and they had different perspectives and expertise with regard to the data. Moreover, the dynamic environment required coordination in many contexts, ranging from formal case review meetings, to chaotic moments in the classroom, to informal interactions with other providers in the school hallway.

Providers responsible for manually capturing data and managing records were consistently overburdened, and the unpredictability of their environment further complicated their responsibilities. If a provider was busy responding to an incident and intervening, he or she would not be able to create the record until later. Recording accurate data in the moment was challenging, and providers adopted unique practices to help them accomplish their work as conveniently as possible, in a way that worked for them. Freeform annotations and note taking, such as jotting down notes on the margins of a piece of paper or on a post-it note, were common. Providers even wrote on their hands during a critical incident when they did not have access to paper. They had researched software options but nothing provided the flexibility of paper.

In the organizations we studied, HIT only came into play when it was required for reporting data to other agencies for billing and auditing purposes. Providers were frustrated with the software's lack of usability and how cumbersome it was to manually transfer data from paper to multiple reports and graphs. Complicating the task of creating records was that providers (and especially record keepers) were responsible first and foremost for children's safety and behavioral intervention. Many informants spoke about the logistical impossibility of balancing all of the tasks they were responsible for: "there is no clerical time within the 40 hr work week, you do billing and paperwork on your own time." There were some efforts to incorporate use of Microsoft Excel and specialized iPad apps into this process, but they were not successful.

Adaptive

Children had unique needs and developed at their own pace, requiring adaptive services. Providers therefore relied heavily on individual children's data to monitor progress and adjust interventions as needed. They recorded data on a child's appropriate social interactions with peers and providers, self-management of emotions, and adherence to instructions and rules. They manually recorded data in the form of quantitative measures (frequency, duration), and qualitative observations (activities or factors that preceded the behavior, details about the nature of the behavior).

The subjective and individual nature of this type of data required a trained behavioral specialist to record events manually and interpret them. Any new technology or device was difficult to introduce in this setting due to the challenges of managing diffuse behavioral data. Behavioral data tended to require a trained provider to observe an event in the real world, interpret the event to record it in a useful way, and then use their understanding of the child to understand what the data revealed about a child's progress over time. These organizations had attempted to incorporate iPad apps and web-based tools for data management, but their persistent use of paper-based records, and struggles to transition to the iPad or specialized applications illustrate a lack of appropriate systems to fit their workflow. Our findings align with those of studies in other contexts that have uncovered problems with, and unintended consequences of, introducing HIT [12, 26, 33, 42]. Our findings suggest that the unintended consequences of HIT are, at least in part, caused by the difficulties of defining problems, standardizing services, and finding appropriate technology.

Another example of providers' struggle with maintaining adaptive services with inadequate HIT was that insurance companies required specific information for billing purposes, such as detailed logs of work hours and activities. Each provider was required to justify their work with each child, sometimes down to the minute, in order to receive each paycheck. School administrators passed down these instructions to their employees, sometimes with specific software to be used for reporting records for billing. Insurance companies requested daily narratives to be written for each child, outlining their treatment and progress. These narratives were to be entered into a poorly designed and time-consuming piece of software. Audits

were common, sometimes once a year, adding to the pressure of having to create detailed and accurate records so as to not create problems for oneself or the organization.

Administrators were in a difficult position, having to adhere to requirements from insurance companies, and passing these down to their employees. Meanwhile, providers were more concerned with the nuances of carrying out a treatment plan, rather than reporting out progress so regularly. Providers were driven to record data that would help them and their team with collaborative reflection for making treatment decisions. They were therefore frustrated when records were required to be created for mere logistical purposes, and took up a significant amount of the time they had with the children. The day before an audit, for example, some providers who typically worked full time in a classroom had to take time completely away from their regular jobs in order to find a quiet place to sit at a computer and work on records. Even more frustratingly, last minute requests for more data continued to come in from their supervisors.

DISCUSSION

The persistent use of paper-based records in special education, and struggles to transition to HIT, illustrate a lack of appropriate flexible systems to fit the behavioral health workflow. This problem is not unique to the context of behavioral health services. A broader literature suggests that paper-based tools persist because they are flexible enough to support informal and mobile coordination [31, 44]. Bardram and Bossen [2] described a need for mobile work in health services. Although their study was in a more time-critical hospital setting, they identified a need to support unstructured aspects of services involving *ad hoc* and unforeseen configurations, not just routines and protocols. Our findings also suggest broader applicability by echoing four of O'Looney's [29] characteristics of loosely coupled organizations (see Table 1): services are adaptive to individual and environmental needs; services are inductive and malleable over time; standardization is avoided; and problems (and technology) are difficult to define.

We found that the primary difference between the organizations we studied and those that provide time-critical services is the loose coupling exhibited in their coordination practices. Our findings show that many of the unintended consequences in the HIT literature [12, 26, 33, 42] can be explained by a mismatch between the flexibility and loose coupling required to provide services, and the inflexibility and overstandardization of HIT that are intended to support these processes.

We present our recommendations for the design of HIT by building on Harrison's [11] concept of organic sociotechnical systems and applying it to HIT. The following recommendations describe how HIT can be organic by incorporating flexible and adaptive qualities.

Health services that are **LONG-TERM**	...tend to be provided by **LOOSELY COUPLED ORGANIZATIONS**	...and are a better fit for **ORGANIC HIT**
Unstructured	Allow for choice, specialization, and a variety of voices and influences	Roles and responsibilities need to be diffuse, flexible, and change through use
Iterative	Provide inductive services customized for individual needs and malleable	Participative forms of decision making and reciprocal interdependencies among stakeholders
Unpredictable	Address problems that are difficult to define, so technology is unavailable or problematic	Decentralized, lateral coordination allows for cross-functional coordination and nonroutine tasks
Adaptive	Need to be responsive and adaptive to individual and environmental needs over time	Coordination through flexible plans, changing goals, and evaluation over long periods of time
Health services that are **TIME-CRITICAL**	...tend to be provided by **TIGHTLY COUPLED ORGANIZATIONS**	...and are a better fit for **MECHANISTIC HIT**
Structured	Provide equitable service delivery for more individuals through rigidly defined roles	Roles and responsibilities need to be specialized, clearly defined, and rigid
Sequential	Deduce individual needs based on assessment and deliver services according to protocol	Coordination based on standard procedures, and evaluation based on clear objectives and standards
Predictable	Address problems that are well defined, so technology is easier to use and diffuse	Hierarchical coordination with top-down emphasis and limited external dependencies
Standardized	Reduce redundancies and promote economies of scale	Bureaucratic emphasis to prioritize efficiency and scalability of services over creativity and innovation
(Present paper)	(Adapted from O'Looney, 1993)	(Adapted from Harrison, 2005)

Table 1. The contribution of this paper is a typology that provides two ends of a temporal spectrum, long-term and time-critical health services. We address a bias toward supporting time-critical care by discussing the rest of the spectrum: how HIT can also support long-term and unstructured aspects of health services.

Based on our fieldwork, we recommend these approaches to organic HIT in order to support a range of health services across a spectrum of temporality.

Roles and responsibilities need to be diffuse, flexible and change through use

We observed that coordination needed to be flexible because the responsibility of maintaining a safe environment and providing all of the children the support they needed was dispersed across providers in the organization.

The records themselves were not effective for coordination. The paper-based records acted as a mechanistic system, and failed to match the need for an organic way of keeping all team members informed and adapting to each situation. When records were not representative or informative enough, providers relied on past experience and anecdotal evidence they gained from informal communication with other providers. Providers were able to ask for support through multiple informal communication channels such as gesturing to a team member, calling to any provider in the hallway, or phoning their assigned supervisor, who was always on call and would answer a mobile phone even during meetings.

In the context we observed, we envision organic HIT that increases awareness and coordination rather than enforcing roles that are dropped when an unpredictable incident must be handled. Because team members share tasks and responsibilities, the conceptual model of the HIT must center on a high level of information flow and a child's individual needs. In addition, communication channels and mechanisms for maintaining awareness across a team could support the diffusion of responsibilities without wasted time or duplicated effort. For example, during a behavioral incident, the most proximal provider would likely be engaging with the student, so location-based features could both predict and respond to an incident without user intervention, notifying other providers or automatically creating a record of an incident. Ultimately, the HIT should be focused not on specific tasks but on each child's progress, and each team members' reflections on that progress – this type of HIT support would then organically lead users to carry out appropriate tasks within a flexible system of coordination.

Participative forms of decision making and reciprocal interdependencies among stakeholders

Distributing roles, tasks, and responsibilities more evenly across stakeholders with organic HIT could not save time and effort, and also improve coordination. We observed close collaboration across providers with different types of expertise and roles, in organizational cultures that were not hierarchical. The knowledge and experience of each provider created reciprocal interdependencies in the process of interpreting a child's data and monitoring progress, a key aspect of collaborative reflection [23].

However, the mechanistic nature of existing practices overburdened some providers with record keeping and made it difficult to keep everyone informed with a child's most up-to-date data. As a result of adequate processes and tools, we observed providers relying more on informal interactions and anecdotal evidence.

As an example of how HIT can have aspects that are both mechanistic and organic: HIT could help record keepers be more efficient with tasks that can be standardized—tasks which make them feel overburdened and undervalued—while providing them with more opportunities to participate in collaborative reflection and decision making. Different stakeholders should have appropriate and flexible tools that allow them more opportunities to be involved with interpretation, sharing, and discussion of data.

Since roles and responsibilities are not clearly defined, HIT should not have a task-oriented focus, defining a user's activities within the organization's workflow. Instead, HIT should encourage collaborative reflection by increasing access to information and allowing for multiple perspectives on data and decisions. Within the constraints of protecting private health data, HIT should give access to as many stakeholders as possible, even read-only, so as to keep stakeholders on the same page and allow them to coordinate around the data. Protection of data and privacy could still be maintained through more sophisticated access control than passwords, and expiration dates for informal notes that do not have to be made a part of a formal record, but can help teams in collaborative reflection.

Decentralized, lateral coordination allows for cross-functional coordination and nonroutine tasks

We discovered conflicting coordination needs across decision makers, which helped to explain the unrealistic expectations for recording practices. A large amount of communication and coordination was required within an organization and to external agencies, and providers did not have adequate support for sharing data across these complex communication channels. Organic HIT should account for different types of stakeholder contacts, communication channels, and information needs across this network—some of which need to be more standardized and streamlined, and some of which need to be more informal and flexible. Some data collection and sharing can be automated, while others require interpretation and reflection on the part of certain providers.

One potential benefit of HIT as opposed to paper-based records is developing interfaces that can be flexible enough to meet the needs of different types of users (*i.e.*, different expertise levels and roles). Reddy and colleagues [38] describe how the different interfaces of a clinical HIT system supported the needs of the various users (nurses, physicians, pharmacists) but at the same time allowed the users to coordinate their activities. This type of mechanism is an example of how HIT can be designed to meet more

varied needs across the spectrum of temporality we have defined in this paper, by balancing structure with flexibility.

Coordination should occur through flexible plans, changing goals, and evaluation over time

We observed a mismatch between the flexible coordination required in these organizations, and the rigidity of records and data management practices. Information systems tend to enforce a structure that does not allow for the iterative process of collaborative reflection. The design of mechanistic HIT focuses on standardized and easy-to-measure data such as blood pressure, cholesterol, or menstrual cycle. Instead, organic HIT could support measures of health status and progress that are more complex to interpret.

Health data could, for example, be represented by more dynamic representations that allow for reflection rather than static representations that tend to be used for quick information transfer. A patient's chart can sometimes be represented by a table of numbers. In the context we studied, this type of static representation was not useful and was often supplemented by anecdotal evidence and opinions. The role of organic HIT could be to provide dynamic visualizations that allow team members to explore and annotate the data in order to interpret it collaboratively.

Likewise, measures themselves should be changeable over time. Some chronic conditions, like diabetes or cancer, can be monitored using the same measures. Behavioral health requires individualized measures that could change over time. Organic HIT, therefore, should allow for both the creation of records and the review of records to account for these types of changes. Data input should be adaptable to the individual and malleable over time. Dynamic visualizations of the data should help providers to interpret progress with the added complexity of varied and changing measures of health.

CONCLUSION

A focus on standardization has led to the design of HIT that tends to overemphasize structure, and not support informal documentation and communication [12, 31, 44]. Informal practices tend to be overlooked in the design of HIT. In striving for standardized and perfect accounts, research shows that HIT actually undermines accuracy in records [33]. In an increasingly complex health care system, there is an "unprecedented requirement for adaptability" [41, p. 15], which HIT is not currently designed for. Studies have revealed that HIT misrepresents communication as information transfer, and misrepresents collective, interactive work as linear, predictable workflow [12].

According to Berg [3], "technology development still all too often tends to be considered as an autonomous or neutral process" (p. 38) – yet HIT is "thoroughly social" (p. 37). A focus on standardization has resulted in what Diana Forsythe refers to as HIT that "delete the social" [10]. Her extensive fieldwork in medical settings showed that because HIT is "designed, built, and evaluated according to procedures that 'delete the social' and mute the voice of users, most of these systems remain 'on the shelf,' a fact which is hardly surprising" [10, p. 15]. The design limitations that caused the low adoption rates Forsythe observed in the 1990s continue to cause the unintended consequences reported today. Rates of adoption have naturally increased given the prevalence of information technology, yet "despite the fact that similar systems had been used outside healthcare for a number of years, definitive evidence of their success in the healthcare domain remains elusive" [17, p. 1].

This paper describes an alternative to standardization in the design of HIT, through an empirical study of paper-based records and technology non-use within behavioral and mental health services. We used temporality as a lens to show that these organizations tend to be loosely coupled and tend to require sociotechnical systems that are organic—*i.e.,* enabling practices that are unstructured, iterative, unpredictable, and adaptive. To support health services over time, we described the design of organic HIT. We envision organic HIT that increases awareness and coordination rather than enforcing roles that are dropped when an unpredictable incident must be handled. Organic HIT should encourage collaborative reflection by increasing access to information and allowing for multiple perspectives on data and decisions. Organic HIT should account for different types of stakeholder contacts, communication channels, and information needs across a network of providers—some of which need to be more standardized and streamlined, and some of which need to be more informal and flexible. Finally, organic HIT should enable the creation and review of records that may need to change over time to account for new or adaptive measures for monitoring chronic conditions.

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