

# Applying Agile Principles to Collaborative Healthcare Teams

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**Abstract:** In this paper, we demonstrate how agile principles can be applied to collaborative healthcare teams. We provide a generic Agile Healthcare Process, and two associated artifacts, the Agile Treatment Plan, and the Agile Dashboard using a theoretical Attention Deficit Hyperactivity Disorder case study. The paper describes these in detail and shows how healthcare teams can measure the success of their collaboration through actionable metrics. Our hypothesis is that providing a process in which collaboration factors are identified and associated with specific performance metrics that can be collected and analyzed, can improve coordination of collaborative healthcare teams. We demonstrate how agile methodology can be applied to manage the treatment of chronic conditions such as ADHD. Our approach anchors around the Agile Treatment Plan and the Agile Dashboard. We show how the KPIs associated with these artifacts can be used to quantify healthcare team collaboration and performance.

## 1 INTRODUCTION

Medical errors – from poor communication, misdiagnosis, poor judgement, and inadequate skills - account for 30% of patient deaths in the US (Anderson & Abrahamson, 2017; Makary & Daniel, 2016). Medical errors can be systematic or linked to individual care providers, but approximately 75% of these errors are the result of teamwork failures (Mayo & Woolley, 2016). While most medical errors are unintended, the negative impact on quality of care can be very significant and sometimes result in the death of the patient.

Chronic health conditions like Attention Deficit Hyperactivity Disorder (ADHD) pose a huge challenge since managing the condition requires collaboration and coordination between healthcare professionals, school authorities, community support and caregivers (Carpentier, 2012). These long-term chronic conditions are most susceptible to medical errors because of the number of different individuals involved in patient care. Therefore, the high incidence of chronic health conditions and the associated benefits of team-based care delivery is one of the major drivers for collaboration (Kuziemy, 2016).

Collaboration can be especially challenging. In addition to clinical domain complexity, care team members tend to have very different roles, perspectives and training (family health, mental

health, community health, and therapies) (Ezziane et al., 2012). Additionally, healthcare policy and regulation pose challenges to team collaboration. In general, healthcare collaboration is complex, which can make coordination, cooperation and communication difficult. These factors make measuring teamwork performance particularly challenging (Sicotte, D'amour, & Moreault, 2002).

In this paper, we discuss performance management for collaborative healthcare teams by using a theoretical ADHD case study. The case study is developed using empirical observation, theoretical research and consultation with experts. We establish the advantages of treating healthcare processes as agile processes guided by an agile treatment plan and dashboard that is managed across the healthcare team, and 2) show that healthcare teams can measure the success of their collaboration through actionable metrics.

It is our hypothesis that if we provide a framework in which a holistic set of collaboration factors and an associated set of specific performance metrics is collected, analysed and communicated effectively, then, care teams will be more effective in coordinating care. This should result in outcome improvements to quality of care that will exceed those from traditional practice.

## 2 BACKGROUND

Managing chronic disease conditions is complex, long-term, and requires multifaceted responses from multi-disciplinary healthcare teams comprised of doctors, nurses, social workers, physiotherapists and other health professionals that provide collective intelligence, over multiple domains for the purposes of diagnosis and treatment (Nolte, Knai, & McKee, 2008). While team collaboration has the potential to improve patient care, in many instances it can have the opposite effect if the teams do not collaborate effectively (Havyer et al., 2014; Zwarenstein, Goldman, & Reeves, 2009). Further, there is a great focus on integrating clinical workflows, with less emphasis placed on team-based collaboration (Eikey, Reddy, & Kuziemy, 2015).

(Eikey et al., 2015) develop a Collaboration Space Model that is based on four main concepts:

- 1) Technology - used by care providers,
- 2) Context – refers to the collaborating teams,
- 3) Processes – refers to collaborative processes, workflows, communication, and information exchange, and
- 4) Outcomes – represent the goals for achieving the desired patient outcomes. While collaboration must be designed to incorporate these four concepts, there is the gap to ensure that outcomes are in line with the desired patient outcomes.

Agile methodology encompasses well-defined methods for organizing collaborative work processes and for measuring performance in software engineering and other fields. Agile methodology is heavily used in managing software development projects and teams (Duka, 2013). It involves breaking up development activities into vertical slices that allow for the incremental release of software to the customer at the end of each sprint (Agile Methodology, 2008; Upadrista, 2015). The strength of agile methodology is that it enables continuous, measurable feedback that gets communicated back to the teams, so priorities and goals are constantly adjusted to be in congruence with the customer needs.

Some early results in the literature show the potential benefits of applying this approach to the healthcare domain (Mayo & Woolley, 2016) (Williams, 2016). Applying agile methodology principles to collaborating healthcare teams means that patient outcomes are continuously evaluated by the collaborating teams. Feedback from the patient and caregivers is received in a timely manner by the teams so medical errors are minimized while the feedback from the patient results in tuning treatment plans to

meet the desired patient outcomes. Based on the work of James Reason (Reason, 2000), Figure 1, shows that each of the collaboration space model concepts is affected by various issues like cognitive overloads, misaligned goals, communication breakdown, and ineffective coordination. These dark (active) holes constitute negative incidents or errors, while the others are latent. When several active holes line up, patient harm occurs through a cascade of these errors.

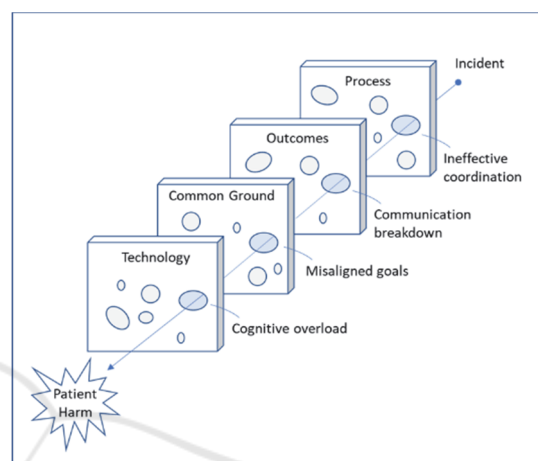


Figure 1: Swiss Cheese Diagram of Collaboration Failure (Reason, 2000).

A key component of agile methodology is the ability to provide measurable outcomes. This requires collaborating healthcare teams to define metrics for measuring success in forms of Key Performance Indicators (KPIs)

In order to monitor care processes, data must be collected and reported to measure how well they are meeting quality of care goals dictated by organizational, governmental, and accreditation regulations. These measures need to be presented and reported to care teams in a simple format such as a dashboard or report that assists them in decision making (Azvine, Nauck, & Ho, 2003).

Shared outcomes and goals for patient health are measured and evaluated in a methodical manner and inform the accountability and efficiency of the team. The agile mindset encompasses values, goals and attitudes for the benefit of the customer, as opposed to the benefit of the bottom line (Denning, 2016). It involves continuous improvement and transparency on an ongoing and daily basis. The communication is egalitarian, open and conversational and occurs independently of hierarchy or position within the organization. The workplace, including the physical workspace, is open and lends itself to collaboration (Denning, 2016)

### 3 A GENERIC AGILE PROCESS FOR COLLABORATIVE HEALTHCARE TEAMS

Agile methodology may be applied to situations where complexity and uncertainty are high. This uncertainty can be related to the scope or even whether a product or service meets customer and market needs (Samaniego & Deters, 2016). Agile methodology can be applied to many aspects of healthcare service delivery involving multiple collaborative healthcare teams. For example, teams within a department in a hospital may work very efficiently. However, when they are required to interact with the greater community (inside and outside the hospital), there is a higher likelihood of issues. (Tolf, Nyström, Tishelman, Brommels, & Hansson, 2015) describe three types of environmental uncertainties that face hospitals, which can be generalized to healthcare organizations: 1) general uncertainties that deal with changing demographics, technology, political and socioeconomic realities; 2) task uncertainties related interaction with other care organizations or individuals such as community care, social care, patients and suppliers; and 3) work uncertainties that describe scientific elements related to the nature of care itself such as certainty of diagnoses, and the ability to routinize diagnoses.

Our generic agile process for collaborative teams leverages agile artifacts as shown in the list below. This list summaries some of the mappings between the terminologies used by collaborative healthcare teams and agile methodology.

- **Sprint Planning:** Sprint Planning
- **Agile Treatment Plan:** Project Backlog
- **Intervention/Action:** Task
- **Ongoing Collaboration:** Daily Stand-up Meeting
- **Final Case Conference:** Sprint Retrospective
- **Agile Dashboard:** Agile Dashboard

In order to illustrate the agile process for collaborative healthcare, we will assume that the patient has been diagnosed with ADHD, and the team is in the process of determining the drug of choice, as well as implementing behavioural modification strategies for learning.

Figure 2 shows how an agile process would see the creation of a virtual team consisting of the physician and psychologist. The teams would create the activities that are part of their treatment as user stories to a scrum backlog. The team would agree on an initial treatment plan at a “Sprint Planning Meeting”, by moving activities from the cross-team “Project Backlog” into the current sprint or Agile Treatment Plan (ATP).

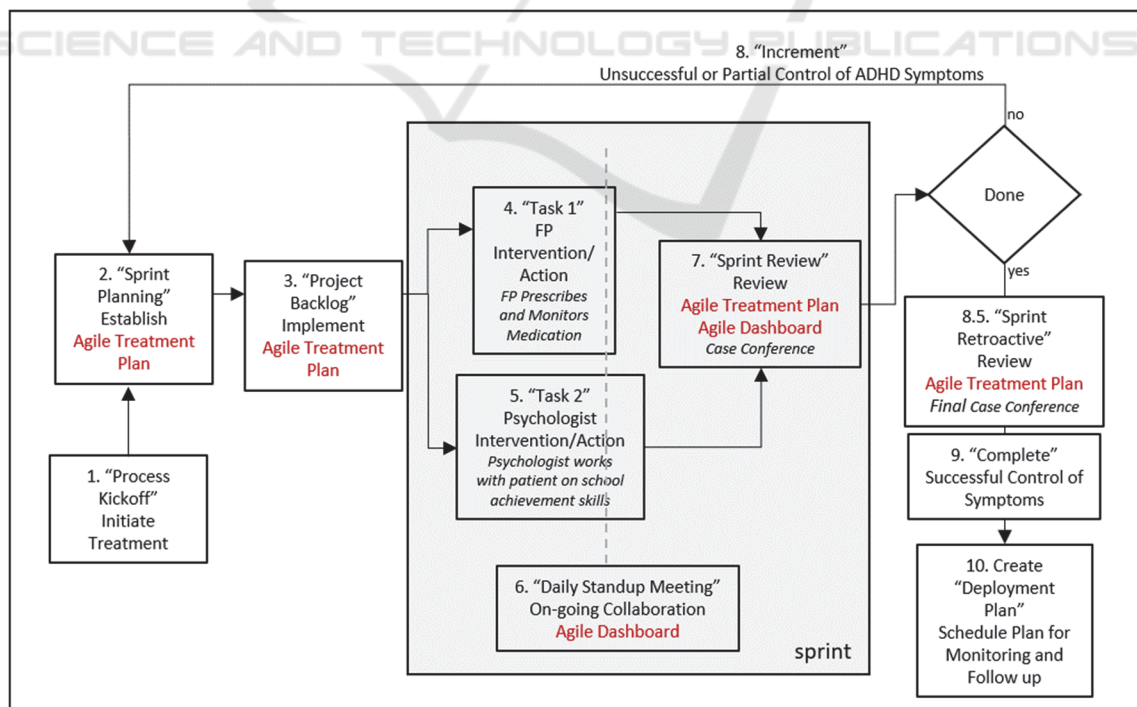


Figure 2: Agile Process.

This initial meeting could include other players such as the patient and parents. At the end of the sprint planning meeting, a treatment plan for the sprint is produced reflecting a commitment made by all teams involved. This plan would organize and prioritize specific interventions related to the broad areas of a patient's life, for example, home, school, friends and peers.

In our example (Figure 2), we focus on learning at school. The treatment plan includes medication which would help reduce the symptoms of ADHD. Therapy is prescribed to help with coping strategies, as well as possibly tutoring help with schoolwork. A variety of interventions would be articulated in the treatment plan to help with the child's development (Jellinek & Mcdermott, 2004).

## 4 ADHD CASE STUDY

Dysfunction of the cerebellar-striatal/adrenergic-prefrontal brain results in the core symptoms of ADHD which involve developmentally inappropriate and functionally impairing inattentiveness and hyperactivity-impulsivity (Solanto, Arnsten, & Castellanos, 2001). ADHD is difficult to diagnose because the core and secondary symptoms of ADHD are exhibited in many childhood disorders. Additionally, many view ADHD symptoms as a kind of variation of normal childhood development. (Rapport, Timko, & Wolfe, 2006). Whatever the etiology, the prevalence of the diagnosis of ADHD/ADD has exploded over the past two decades. Parents become aware of behavioural issues that manifest in a child's or adolescent's education or social interactions and, justifiably, look for solutions to help them.

In current practice, the healthcare team for a child who has been diagnosed with ADHD is the primary care physician, parent(s), teacher, and if possible, the child. Each of these team members plays a role that yields the most effective outcomes for the child.

The role of the physician is to diagnose, prescribe medication, recommend community resources for behaviour and support (such as psychologists), and on-going monitoring of the child's progress (*Canadian ADHD Practice Guidelines, Third Edition, 2011*).

The role of the educator is to implement, enforce and document academic and behavioural strategies during school hours. Once ADHD is successfully diagnosed, there is strong evidence that treatments with high acceptability and adherence yield the best outcomes for school-aged children with ADHD.

ADHD is a disorder that is best treated with a combination of drugs and behavioural therapy (MTA Cooperative Group, 1999; Subcommittee on Attention-Deficit/Hyperactivity Disorder & Steering Committee on Quality Improvement and Management, 2011).

The role of the parent is to execute recommendations of the family physician and psychologist, to monitor the effectiveness of the administered medication, to act as an intermediary between the school and the healthcare system, to advocate for the child, and to be a contributing member of the agile team.

The team in this scenario includes the family physician Dr. Jones, the psychologist, Dr. Martin, Mary Smith, the patient, and Mary's mother. The educator has been excluded for simplicity.

Due to the collaborative nature of treatment, ADHD is used as a case study to elaborate on our model and validate its applicability. We aim to assess/evaluate whether or not care teams will be more effective in coordinating care if they adopt or generic agile process for collaborative care.

### 4.1 Agile Treatment Plan

The Agile Treatment Plan (ATP) is a document that establishes the roles and responsibilities of each team member. This helps in clarifying the importance of the role of the patient in the process and set expectations. For example, if the patient is not compliant in taking the medications, then the process is deemed a failure and will not be marked as complete – allowing the team to try a different approach in subsequent sprints. In addition, an ATP would specifically outline what drug is being titrated, as well as the expected reaction to the drug. It could also specify a meeting plan which would be agreed upon by all team members.

A sample Agile ADHD Treatment Plan is shown in Figure 3. In a typical Agile Scrum sprint, the "Daily Stand-up Meeting" takes place every day for 15 minutes; however, this is highly unfeasible. Therefore, we adapt the process for the team to meet on a regular basis at a mutually agreed-upon time, for a short duration (15 min), to answer three agile-based questions as needed:

- a. What did you do previously?
- b. What are you doing currently?
- c. Are there any impediments in your way?

Each member of the team provides information or other assistance to help with impediments as needed. The team is flexibly agile and governs itself around the treatment needs of the patient. It should be noted

Agile Treatment Plan			
Name: Mary Smith DOB: July 1, 2006		Current Date: October 11, 2019	
<b>Problem/Symptom:</b>			
Current symptoms of ADHD include periods of inattentiveness, frustration, irritability and poor self esteem. In addition, over the past few months Mary has had difficulty coping with stressors; she has reacted to stressors with a brief increase in depressive symptoms, including increased sleep, suicidal thoughts, and loss of interests.			
<b>Long Term Goal:</b>			
Symptoms of ADHD will be significantly reduced and will no longer interfere with Mary's functioning at school.			
<b>Short Term Goals/Objectives:</b>		<b>Date Established</b>	<b>Projected Completion Date</b>
1. Alleviate physiological symptoms of ADHD		September 1, 2019	June 1, 2019
2. Help Mary be successful at school for current school year		September 1, 2019	June 30, 2019
<b>Intervention/Action:</b>		<b>Responsible Person</b>	<b>Short Term Goals/Objectives:</b>
1. Determine best medication for Mary and monitor her progress.		Dr. Jones	1. Alleviate physiological symptoms of ADHD
2. Mary will take medications on a regular basis as prescribed and report on how she is feeling.		Mary's Mother	1. Alleviate physiological symptoms of ADHD
3. Dr. Martin will outline and execute a plan to help Mary success at school.		Dr. Martin	2. Help Mary be successful at school for current school year
4. Mary will work with Dr. Martin and diligently apply the recommendations from Dr. Martin.		Dr. Martin	2. Help Mary be successful at school for current school year
<b>Review Meetings:</b>			
Date: Oct. 11, 2019	<b>Short Term Goals/Objectives: 1</b>		
Reported by: Dr. Martin	<b>Intervention/Action: 3,4</b>		
	<b>STATUS: YELLOW</b>		
	Mary has not been responding well to current therapy. As a result, I am initiating a new assessment to determine if there are any underlying issues. At the current time, I recommend a case-conference be held with Mary's parents as well as her teacher and guidance councillor. I believe that an Individual Education Plan (IEP) should be initiated in order to help Mary access the curriculum.		
Date: Oct. 11, 2019	<b>Short Term Goals/Objectives: 2</b>		
Reported by: Dr. Jones	<b>Intervention/Action: 1,2</b>		
	<b>STATUS: YELLOW</b>		
	Mary has demonstrated no change in symptoms. I am increasing titration to 15mg methylphenidate.		

Figure 3: Agile ADHD Treatment Plan.

that each member of the team becomes a source of expertise in their own discipline, with a recognition that success can only occur when all members are fulfilling their responsibilities. The treatment plan is updated according to feedback from the regular meetings as necessary. Because of regular sprint-like meetings, the team becomes agile and can be responsive to issues that arise from drug incompatibility for example. Iteration may occur, and once successful, a final case conference will be held where there will be an agreement regarding the outcomes and next steps.

### 4.2 Agile Dashboard

The objective of this artifact is to provide a snapshot status at any time before, during or after a sprint. The elements of the dashboard are the iteration number,

the sprint number and the status of each Intervention/Action of the current sprint. Figure 4 shows an example of the beginning and middle of a sprint. The status of the intervention is indicated by red=fail, yellow=jeopardy, and green=good.

The Agile Dashboard (AD) provides a mechanism to monitor the status of all the KPIs associated with the overall treatment plan. It provides not only the quick operational summary of the treatment, but it also flags the risks, and blockers so early intervention can be put in place to mitigate against those.



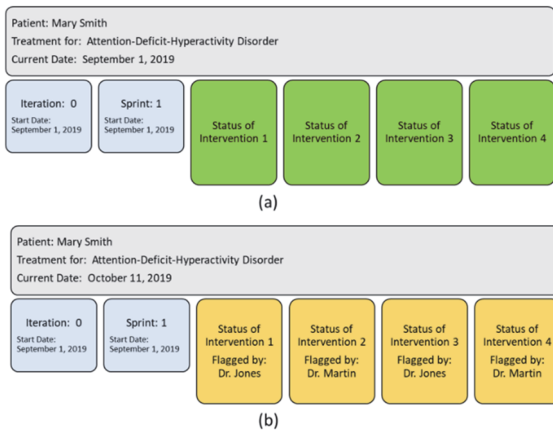


Figure 4: Agile Dashboard at the Beginning (a) and Middle (b) of a Sprint.

## 5 PERFORMANCE MANAGEMENT OF HEALTHCARE COLLABORATIVE TEAMS

The Agile Treatment Plan and Agile Dashboard are useful tools for enabling, standardizing and automating communication between the different actors in the collaborative healthcare team.

Table 1: Healthcare Agile KPIs.

KPI	Description	Unit	Example
WoS	Workflow on Schedule	Yes	Team is meeting as agreed upon
		No	Team is not meeting as agreed upon
		Jeopardy	There is a risk that the team is not meeting as agreed upon
		Unknown	Schedule not updated due to technology failure
Mod	Modality	% self	Patient administering care to self
		% in person	Care being given by the parent
		% remote	Care being monitored by physician
SS	Success Status	Green	Task complete and successful
		White	Task incomplete
		Yellow	Task incomplete – in jeopardy
		Red	Task complete and unsuccessful
DB	Dashboard	Mixed	All KPIs would be shown on the dashboard in addition to technology effectiveness
TEC	Technology	Success	Tools working
		Fail	Tools not working.

The data from these artifacts can be useful for performance management of Healthcare Collaborative teams. Performance management in this context would help professionals analyse how effective their interventions/actions are for the individual as well as over a large swath of patients, without actually monitoring their actual treatment. Accordingly, performance metrics are related to team collaboration, and not individual team member performance. Some examples are shown in Table 1.

We specifically chose KPIs related to collaboration, while avoiding those related to specific areas of clinical expertise such as “appropriate diagnosis” or “effective medication” for example. The objective is to measure key aspects of team performance such as whether they were meeting regularly, how are they meeting (in person or remotely), whether they thought they were being successful and whether the technology they are using is working for them. Other KPIs can include whether the workflow is on schedule, how often the technology breakdown and causes problems.

## 6 DISCUSSION AND FUTURE WORK

In this paper, we have shown how agile methodology can be applied to making collaborative healthcare teams more effective. Our approach revolves around the Agile Treatment Plan and the Agile Dashboard.

The application of agile principles results in several improvements. For example, team members are aware on a daily basis of patient status in terms of what is being done (Agile Treatment Plan) and how the patient is progressing (Agile Dashboard). Rather than each individual team member having their own treatment plan, and ad hoc measurements of indicators for progress, this approach provides conformity and continuity between modalities and treatments. Team consensus is established at the beginning of what the goals are and how they will be measured (dashboard) in a formalized way.

Importantly, the process of care follows a simple structured template rather than being ad hoc and adverse event-driven. Another important factor is that the composition of the team is flexible and configurable (for example, the patient, parent or teacher or pharmacist can be part of the team). Different members with different roles and knowledge can easily plugin. Finally, performance management is now enabled and quantifiable.

There are several challenges to the application of an agile methodology to healthcare processes. For example, the ATP represents yet another form for practitioners to be concerned with. An Agile Dashboard will have the same issue since there are several support tools. Hence the adoption of these artifacts may be an issue due to cognitive overload, management of information, hosting and other IT issues. A further issue is on reaching agreement on KPIs, their meaning and use.

An area of the agile methodology that would improve collaboration is a common language and terminology. There are several ways that this could be achieved. Firstly, placing an emphasis on the functionality of the patient, rather than the disease, may be an effective way to enable common ground through common language use. This would also shift the emphasis from treatment to management and creation of healthy living within the context of illness. Secondly, in order to further create a common understanding, we believe that an ontology for collaborative healthcare that consists of actors, their relationships, how communication occurs, what information is communicated, and what is done with this information, be developed.

## 7 CONCLUSION

In this paper, we have shown how agile methodology can be applied to manage the treatment of chronic conditions such as ADHD. Our approach anchors around the Agile Treatment Plan and the Agile Dashboard. We have shown how the KPIs that form these artifacts can be used to quantify healthcare team collaboration and performance. We also articulated some areas of improvement that could be evident should if an agile approach is used. Finally, we articulated some challenges and the need for an ontology and common communication based on functionality, rather than ailment or disease.

In summary, the application of Agile methodology to healthcare would require managers/administrators to empower knowledge workers to find solutions, rather than control the team. It requires healthcare teams to become self-organizing, autonomous, and have the ability to function as a network of teams. Coordination of work would occur in an iterative manner, free of bureaucracy, while at the same time being structured. Practices would be customer-focused, and mission-critical.

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