RESEARCH REPORT

How to measure the collective intelligence of primary healthcare teams?

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Abstract

Introduction: The capacity for teams and organizations to evolve and to thrive in ever-shifting environments is attributed to their collective intelligence. Collectively, intelligent team could prevent repetition of past mistakes and can help organizations and people work more efficiently. Researchers aimed to find a framework or a tool that could help explain collective intelligence in primary healthcare organizations.

Methods: The framework was developed iteratively following a three-step process based on the Pragmatic utility concept analysis, each step fetching data from both literature and the team's expertise: (i) finding an existing framework, (ii) developing an initial framework, (iii) testing and refining the framework.

Results: A broad literature search led researchers to focus more specifically on two interrelated frameworks, both concepts were created within the educational field. We first adapted these concepts to healthcare teams, then to the increasing interdisciplinarity of primary healthcare teams. We also subdivided the framework into clinical or organizational domain. Finally, we performed a secondary analysis from existing data of a larger project that aimed to evaluate seven primary care teams in Quebec.

Conclusions: This first attempt to conceptualize collective intelligence in a way that is specific to primary healthcare teams helps identify strengths and areas in which teams could potentially improve. From a theoretical perspective, the framework facilitates understanding of the concept of collective intelligence in primary healthcare teams. Our current results show a strong potential for this tool, but other tests and systematic validations are to be expected in order to better link collective intelligence and team performance.

KEYWORDS

collective intelligence, collective learning capacity, healthcare organization, learning organization, primary healthcare team, team learning

1 | INTRODUCTION

Innovation is accelerating at a rapid pace,[1] contributing to the complexity of healthcare systems.[2] Teams and organizations involved in healthcare work and exist in ever-shifting environments where changes, though at times carefully strategized, can also arise unexpectedly.[3] Healthcare teams must therefore adapt to changing contexts, create solutions to complex problems

all the while provide care and perform a wide array of tasks.[3,4]

The capacity for teams and organizations to evolve and to thrive is attributed to their collective intelligence.[5] Granted no accepted definitions can be found, according to Salminen,[6] collective intelligence refers to the demonstration of the system's behaviour on the macro-level that emerges from interactions and individuals at the micro-level. Collective intelligence is concerned with the decision-making and actions of complex adaptive social systems.[7,8] It is the demonstration of the collective's ability to learn and to act to overcome challenges, namely through the processing of information and the utilization of available resources, in relation to the purpose of the organization or the team.[9]

Collective intelligence materializes in part based on how well the group collaborates, so it is examined with the perspective that individual actions become a collective system.[9] In this manner, collective intelligence can be linked with interprofessional collaboration.[10] Other fields look at collective intelligence with a focus on "Intelligence" itself: the ability to learn, to understand, and to adapt to the environment and influence its context.[9] This includes each person's individual learning capacity and his or her involvement in continued education, but it is also more than the simple tallying of each team member's individual intelligence.[11,12]

Prior research seems to indicate that a collectively intelligent team could prevent repetition of past mistakes and can help organizations and people work more efficiently.[13] Collective intelligent teams would have higher flexibility and could quickly exchange knowledge, make faster decisions, swiftly plan and make changes when necessary.[13] This seems particularly important for the healthcare system as there is an increasing reliance on interprofessional teams to provide better healthcare services[14,15] and the literature is awash with examples of how traditional hierarchies in practices have proved detrimental to the serviceability of collective intelligence.[16-18]

2 | RESEARCH INTERESTS

The plethora of concepts tangled with collective intelligence may be the consequence of the fact that a great number of different fields are interested in it. For example, education may look at collective intelligence as a tool to promote learning,[19] whereas the computer science field may be more interested in how to design systems in a way that allows the development of collective intelligence.[20] Furthermore, administration, business and management may look at what should be put in place to insure the governance of collective learning in organizations,[21] or at how to use collective intelligence to enhance performance,[22,23] whereas psychology, sociology and anthropology are concerned with different dimensions of this concept.

Therefore, although collective intelligence is an interesting concept one interested in evaluating a healthcare team's collective intelligence may be quite confused. As of yet, there does not seem to be an accepted framework for studying collective intelligence, which makes research regarding this concept quite challenging.[6]

This article is part of a larger research project that aims to analyze the organizational parameters favouring performance according to the dimensions described by[24] among seven Integrated Primary Care Teams (IPCTs).[25] One component of this project is a developmental evaluation to support teams to learn from experience. This developmental evaluation involves semi-structured interviews and participatory observations. This form of evaluative approach allowed the research team to be present at several meetings or reflective interactions of professionals allowing direct access to the daily processes of collective intelligence. The researchers tried in vain to apply the different tools and dimensions used in several scientific fields to analyse the collective intelligence of this seven teams.

In fact, primary care clinics depend very little on managers to improve organizational performance, and if the organizational parameters influence the different professional roles,[16,26-29] the latter are mostly standardized and evaluated by the professional orders on the clinical aspect. This tension between the clinical field and the organizational field leads to a different consideration of professional points of view, which is contrary to a collective vision of the collective intelligence that underpins the integration of all stakeholders in the reflection process. Following Pfadenhauer recommendations,[30] the research team determined that the underlying framework had to be contextually relevant to healthcare, must have had at the very least considered all professionals as equal partners, and addressed all ventures with the same degree of focus whether they be clinical or organizational.

3 | METHODS

The framework was developed iteratively following a three-step process, each fetching data from both literature and the team's expertise.[30] The first step is a scoping exercise followed by a rapid assessment of the literature. The second step is composed of the revision of the framework using the Pragmatic Utility Concept Analysis. For our study, the third step consists of the test of the framework by the way of the qualitative systematic review that allow to modify the framework where contextual and deductive findings did not fit.

3.1 | First step: Finding an existing framework

In the first step, the team performed literature searches for models, theories and frameworks regarding collective intelligence using the following terms: "(Collective intelligence) OR (collective learning) OR (Learning capacity) OR (Collective learning capacity) OR (swarm intelligence) AND (dimension) OR (tools) OR (measure) OR (framework) NOT (finance) NOT (software)." We examined different publications (see the table in supporting information) emerging from any kind of field such as healthcare, education or organization management, but quickly realized that no existing collective intelligence framework was readily available for the analysis of the attributes of primary healthcare organizations. Despite widening our search to potentially

related topics such as "Collective learning capacity," "team learning," "wisdom of crowds," "collective problem-solving," "swarm intelligence"[5] and "organizational learning" or "learning organization",[6] we still could not find frameworks directly relevant. It should be noted that the literature review was complicated by the fact that many articles do not offer a definition for the concepts they cover.

3.2 | Second step: Developing an initial framework

We examined the publications identified in this manner and, following the second step of the Pragmatic Utility concept analysis,[30,34] we built an initial integrative framework that was drawn from Decuyper et al[32] and Raes et al.[33]

3.3 | Third step: Testing and refining the framework

The initial framework underwent testing throughout its application. It was applied to the data extracted from the broader IPCT project, a project designed to elucidate primary care delivery models likely to improve the accessibility, quality and efficiency of care.[25] A secondary analysis of this data was performed: the initial collective intelligence framework was applied by different researchers, and examined for applicability, coherence, completeness, usefulness and ease of application. We collected feedback from the researchers who had participated in the various applications and discussed inconsistencies or problems raised. The refining of the framework involved three inductive and deductive cycles of analyses where questions were raised, literature was consulted, dimensions of the framework were refined, tests were performed and the results were appraised and discussed.

4 | RESULTS

The results for each step are presented, namely the search for an existing collective intelligence framework, its initial development, refinement and the completed final model.

4.1 | Existing frameworks

A broad literature search led researchers to focus more specifically on two interrelated frameworks specifically applicable to team learning. (i) The systemic, cyclical and integrative team learning model[32] and (ii) a related coding system that was created to identify the actual team learning behaviours that could be observed by individual verbal contributions rather than individual perceptions[33] (Table 1). These two frameworks share many similarities and, with adjustments, have the potential to become relevant tools for the analysis of collective intelligence in the context of primary care.

First, the philosophical underpinning of the systemic, cyclical and integrative team learning model is consistent with the way the research team defined collective intelligence that is by adopting a dynamic and complex system perspective. Second, the scope of the study is noteworthy as the model was based on a review that revealed 486 different variables related to or central to team learning. It is the clustering of these different variables that resulted in the team learning model of eight different interrelated team learning processes: (i) sharing, (ii) co-construction, (iii) constructive conflict, (iv) team reflexivity, (v) team activity, (vi) boundary crossing, (vii) storage and (viii) retrieval. Third, although the authors seemed to be mostly concerned with education, the literature emphasized, to a larger extent, interdisciplinary applicability because it explicitly crosses the boundaries of the different scientific disciplines and sub-disciplines involved in the study. While not specifically created to analyse collective intelligence in primary healthcare teams, all eight procedures seemed relevant.

In this regard, Raes et al[33] built upon learning process themes elucidated by Decuyper et al[32] with the help of the work-team learning model by Edmondson[35] to establish a framework on basic team learning behaviour (Table 1). Raes et al.[33] itemized six of the themes advanced by Decuyper et al[32] into 22 observable basis team learning behaviours.

Both frameworks possessed certain limitations preventing their immediate use when analysing data on healthcare groups. First, neither article offered a clear definition of team learning. The research team therefore had to infer its relation to collective intelligence. Furthermore, both concepts were created within the educational field. The applicability of these concepts in healthcare had to be articulated. It was unclear if these included the concept of "transactive memory" (ie, knowledge about each other's knowledge). The existing framework affirms that co-construction is the mutual creation of knowledge through the process of refining, modifying or building on information, knowledge and competences shared by one of the team members[32]; this can be observed from the following: (i) Team members collectively draw conclusions from ideas discussed in groups, (ii) Information from team members is completed with information from other team members, (iii) Team members elaborate on each other's information and ideas.[33] Transactive memory could not be distinctly linked with these elements. Similarly, the research team could not determine whether the concept of "mutual learning" was included or should be distinguished from "co-construction." Other areas that required clarifications to implement these ideas to healthcare teams related to constructive conflict. The research team questioned whether team conflicts were similar or different when the team faced a crisis.

4.2 | Developing an initial integrative framework

At this initial stage, the phraseology developed by Raes et al[33] on the itemization of the six themes developed by Decuyper (2010) was slightly modified to better characterize the healthcare field.

TABLE 1 Existing frameworks

Decuyper et al[32]		Raes et al[33]
Themes	**Definition**	**Indicators**
Sharing	"This is the utterance of new information, a vision, a meaning, an idea, a proposal, etc. by one of the team members to the other."	The team, shares all the relevant ideas and information
		The team members listen carefully to one another
		The team discusses items that are unclear
Co-construction	"Co-construction is the process of the mutual creation of knowledge by refining, building on or modifying the information, knowledge and competences shared by one of the team members."	Team members collectively draw conclusions from the ideas discussed in the teams
		Information from team members is completed with information from other team members
		Team members elaborate on each other's information and ideas
Constructive conflict	"Constructive conflict is what occurs when team members encounter a conflict or discussion as a consequence of their diversity and the open communication in which this diversity is exposed."	How ideas are acted upon
		Opinions and ideas of team members are verified by asking each other critical questions
		This team tends to handle differences of opinions by addressing them directly
Team reflexivity	"Team reflexivity, refers to the team's action of reflecting on the current reality and on how to adapt to the current and future reality to achieve the team goals. Teams that engage in team reflexivity are not only able to question the extent to which they achieved or are achieving their goals; they also question their goals, their approach to reach them, the underlying conditions and the established way of working together. [Intrasystem learning]."	The team steps back from daily routines to consider whether the methods used are the best available
		The team often reviews its objectives
		The methods used by the team are often discussed
		The team regularly considers whether work performed meets project objectives
		We regularly discuss whether the team is working effectively together.
		How well we communicate information is often discussed
		The way decisions are made in this team is rarely altered
Team activity	"Team activity occurs when team members take joint action to work with each other physically and/or psychologically."	The team experiments with new working methods
		Our team tests new working methods
		Together we plan to test new working methods
Boundary crossing	"Boundary crossing is the team taking initiative to cross its borders, that is, sharing and asking for information and feedback with/from other individuals or units outside of the team."	Team members go out of the team to get all the information they possibly can from others—such as consumers, or other parties of the organization
		This team frequently seeks new information that leads us to make important changes
		The team invites people from outside the team to present information or have a discussion

For example, the following item: "Team members go out of the team to get all the information they possibly can from others—such as customers, or other parties of the organization" was changed to, as recommended by some authors[29,31] to enlarge this item in order to evaluate if the team look in its environment various solution to improve or resolve a crisis: "Team members independently split from the team to get all the information they can acquire from others—such as patients, other healthcare teams of the organization, or other sources outside the organization." Other alterations presented in red in Table 2 were intended to better define the terms used according to the limits presented in the preceding step of the analysis of existing frameworks.

Furthermore, as empowerment[28,29,36,37] and interdisciplinarity[25] become strong factors in teams, the traditional partition of work between caregivers and managers is gradually being phased out, and different professional groups are being acknowledged as capable of bringing added value to team deliberations. This refers to the size contribution[31] which means to the degree of contribution, often limited, of the actors in the creation of solution. More healthcare professionals, notably nurse practitioners, are getting involved in organizational decision-making processes due to their expanding fields.

For this reason, and to go beyond specialized knowledge,[29] it seemed necessary to subdivide the framework on the basis of whether the observable team learning behaviour was intended for the clinical or rather the organizational domain, here called "team functioning" (Table 2). Indeed, the research team observed that it is common,[16,38] for example, for nurses to be part of clinical discussions and be excluded from strategic or organizational decisions, leaving them with incomplete information and leading towards decisions that do not consider their expertise.

TABLE 2   Final refined primary healthcare team collective intelligence tool

Dimension	Component	Element	Focus	
			Clinical	Team fun.
The collective	Sharing	The team, shares all relevant ideas and information		
		The team members listen carefully to one another		
		The team discuss items that are unclear		
Mix (0 = only one person, 1 = One job title, 2 = Two job titles, 3 = Three or more job titles)	Co-constructing	Team members collectively draw conclusions from the ideas that are discussed in teams		
		Information from team members is completed with information from other team members		
	Constructive conflict or crisis solving	Comments on proposed ideas are considered and put into practice if necessary		
		Different or opposing opinions and ideas from team members are scrutinized by asking one another critical questions		
		This team tends to handle differences of opinions by addressing them directly		
The intelligence/ learning dimension	Mutual learning	Team members learn from each other, share knowledge		
		Everyone knows the roles of each member of the team (transactive memory)		
	Reflective observation	The team considers whether the methods used are the best available		
Frequency (0 = never, 1 = sometimes, 2 = often)		The team often reviews its objectives		
		The methods used by the team are often discussed		
		The team regularly considers whether work performed meets project objectives with an emphasis on real evaluation of programs/services		
	Active experimentation	The team invents new working methods		
		The team experiments with new working methods		
	Boundary crossing	Team members independently split (from the team) to get information from others—such as patients, other healthcare teams of the organization, or other sources outside the organization		
		This team frequently seeks new information (from literature or experts)		
		The team invites people from outside the team to present information or have a discussion		

4.3 | Testing and refining of the integrative framework

In order to test the initial framework, the research team performed a secondary analysis from existing data of a larger project that aimed to evaluate seven primary care teams, IPTC.[25]

The data used came from individuals (n = 34) and 17 semi-directed interviews conducted between October 2014 and February 2017 with key participants (managers, physicians, nurses, community stakeholders and other professionals) in the seven primary healthcare teams. These seven teams are considered innovative in terms of clinical practice since they involve different types of professions, thereby lowering the ratio of general practitioners, unlike other clinical settings in Quebec. Moreover, they lean more towards intensive nursing care, magnified to a broader scope of practice. Respondents were selected for their knowledge of the clinic, its origins, how the clinic operates, and the services it offers. Two programmers tested the initial framework and discussed their results. Along with the research team, they further refined and tested the final framework (Table 2).

4.3.1 | Dimensions and components

The initial framework was tested to allow researchers to extract two encompassing dimensions: collective dimension and intelligence-learning dimension, as summarized in Figure 1 below.

Shedding light on "Intelligence-learning" dimensions, we highlighted parallels between categories delineated by Decuyper et al[32] and the learning cycle brought forth by Kolb and McCarthy.[39] Furthermore, the research team felt that the "reflective observation" described by Kolb and McCarthy[39] was more specifically in reference to a sort of group metacognition rather than the "team reflexivity" described by Decuyper et al.[32] Moreover, "active experimentation" more precisely refers to active testing of new ideas rather than "team activity" depicted by Decuyper et al,[32] which could be confused with team productivity. This distinction between the activation of new ideas and the productivity of the team is consistent with the organizational literature analyzing Dynamic Capability View.[28,29,40] These dynamics describe the tensions between the need to respond to the objectives of organizations (here delivery of care) and the need to intentionally change knowledge and routines for continuous improvement. Viewing "reflective observation"

FIGURE 1 Final framework of collective intelligence for primary healthcare team

and "active experimentation" as more explicit, the research team opted to use both labels (Table 2).

4.4 | From primary healthcare team collective intelligence framework to an analysis tool

The final refined primary healthcare team collective intelligence framework therefore includes two dimensions: collective dimension and intelligence-learning dimension. Both are refined into components and elements that are evaluated according to clinical or team functioning. The collective dimension is evaluated according to the diversity of professions involved, and would include the following components: "sharing," "co-constructing," and "constructive conflict or crisis solving." The intelligence-learning dimension is evaluated according to the frequency of actions. It includes "mutual learning," "reflective observation," "active experimentation" and "boundary crossing."

4.4.1 | Frequency of behaviours and professional involvement

The test also highlighted that, in addition to the frequency of behaviours previously proposed by Raes et al,[33] it was necessary to include the professionals involved. The research team made an effort to adapt the titles so that not only would the frequency be considered, but also who was involved in the behaviour. For example, we wondered if for the "sharing" component in the "individuals shared all the relevant ideas and information" element, it was the frequency or rather the mix of professionals that better highlighted the inner workings of the team. Indeed, it is not uncommon in organisational analysis to not take into account the influence of power into the dynamic of sharing, deciding and learning.[36] The team decided on the latter and categorized each of the collective dimension elements into four levels: 0 = only one individual, 1 = one job title, 2 = two job titles, 3 = three or more job titles. In comparison, for the intelligence-learning dimension, the frequency measurement suggested by Raes et al[33] was kept: three-point scale: never, sometimes or often.
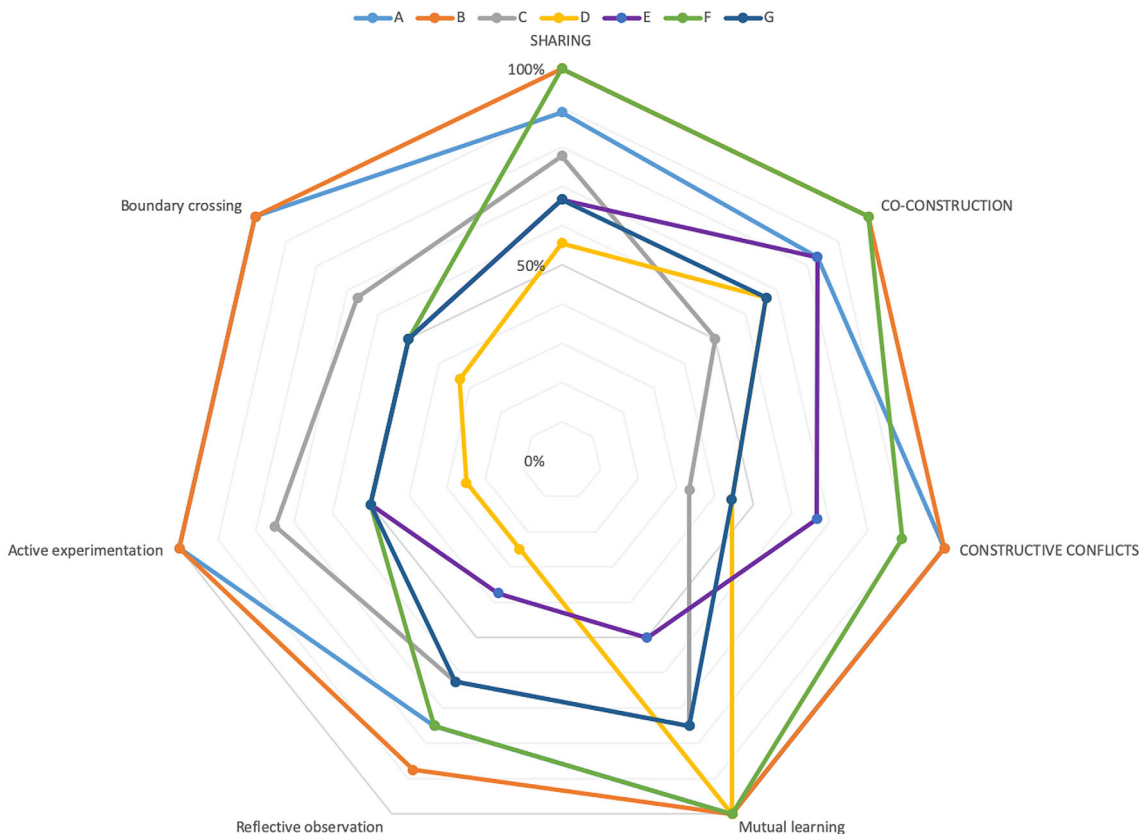

FIGURE 2 Illustration of results using primary healthcare collective intelligence framework: clinical dimension of the collective intelligence for each case
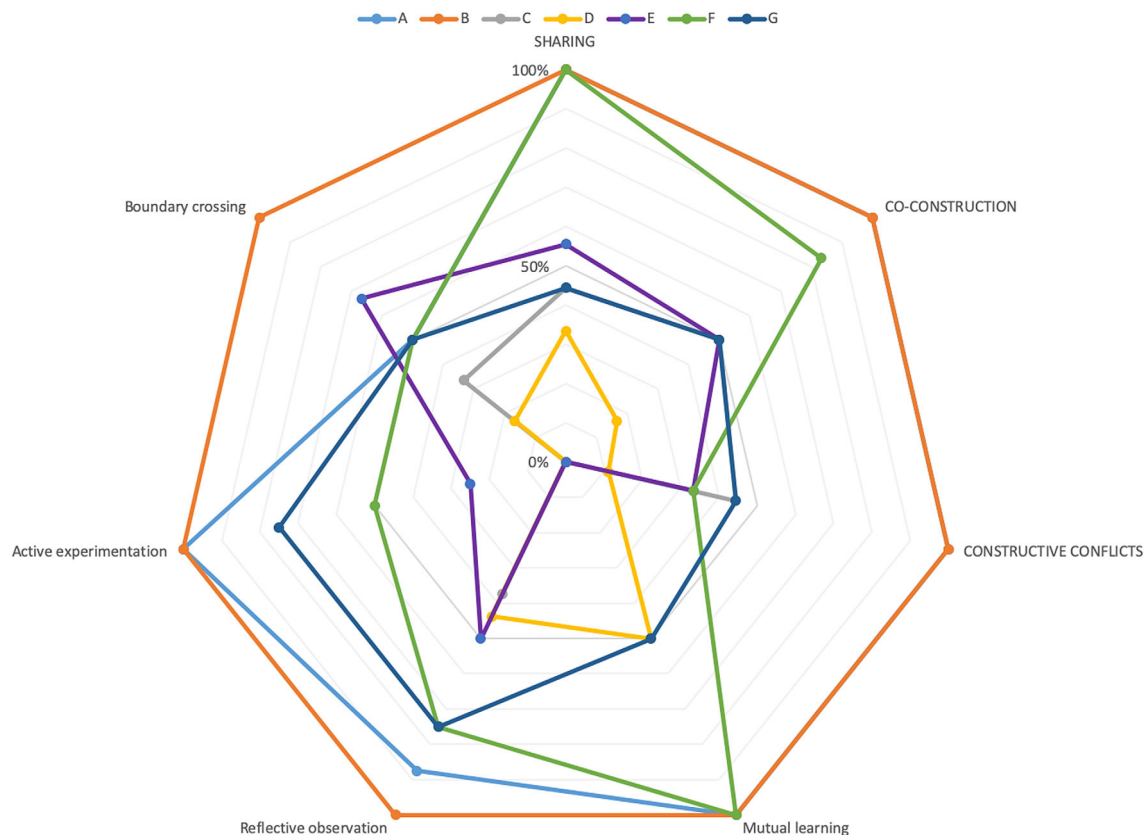
FIGURE 3   Illustration of results using primary healthcare collective intelligence framework: team functioning dimension of the collective intelligence for each case

By conceptualizing and organizing collective intelligence along these lines, it is possible to evaluate primary healthcare teams when working with collective and intelligence-learning dimensions, and focusing on either clinical or organizational actions. An example of the application's results is illustrated in Figure 2 and Figure 3, and will be described in a future article. It is already possible to observe the sensitivity of the tools to differentiate the seven cases, since the latter have very variable results. Similarly, these figures are consistent with the fact that healthcare professionals are more used to and trained to collaborate and think while having a greater power of action at the clinical and organizational levels, a field traditionally more invested by managers.

5 | DISCUSSION

Providing high quality healthcare services is more than a matter of placing intelligent people in the same setting and demanding that they change the manner in which they work together.[14] Learning capacity is a dimension of performance[24] and it is believed that highly functional collective intelligent teams produce high quality clinical services. In order to validate this argument within the healthcare field, it is essential to better understand the concept of collective intelligence. While pulled from a rich source material, this is, to our knowledge, the first attempt to conceptualize collective intelligence in a way that is specific to primary healthcare teams. This tool describes the different

dimensions of collective intelligence and brings forth critical reflection of the teams' various objectives (clinical, team functioning). It adds onto pre-existing conceptualizations, adapting them to reflect more closely healthcare teams. It can currently help identify strengths and areas in which teams could potentially improve.

There is still a lot to achieve. The psychometric properties of this concept will be tested. At the team level, it will be interesting to see if it is possible to associate better patient outcomes using a specific configuration of collective intelligence. For example, will it be teams with better scores in terms of clinical focus that will achieve the best patient results? To be an efficient healthcare team, is it more important to work collectively or more important to learn together? Building a refined framework for collective intelligence in primary healthcare teams is the first step in solving the many questions that remain unanswered.

CONFLICT OF INTEREST

The authors have no conflict of interest regarding this research.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.