From Care Plans to Care Coordination: Opportunities for Computer Support of Teamwork in Complex Healthcare

Ofra Amir, Barbara Grosz, Krzysztof Gajos Harvard School of Engineering and Applied Sciences Sonja Swenson, Lee Sanders Stanford University

The Care for Children with Complex Chronic Conditions



The Care for Children with Complex Chronic Conditions



Team-Based Care Plans for Improved Coordination (LPFCH, 2014)

Goals	Actions	Caregivers
Move to oral feeds	 Improve mouth muscle tone Adjust formula for weight gain 	PCP, GI, OT, nutritionist
Start daycare	 Minimize need for tube feeds Assess therapy needs 	Parents, PCP, nutritionist, home nurse
Go on family trip	 Arrange portable equipment Arrange funding and transportation 	Parents, PCP, PT, social worker

Team-Based Care Plans for Improved Coordination (LPFCH, 2014)

Goals	Actions	Caregivers		
Move to oral feeds	 Improve mouth muscle tone Adjust formula for weight gain 	PCP, GI, OT, nutritionist		
Rationale: everybody "on the same page" In practice: rarely deployed or consulted				
Go on	Arrange portable equipment	Demonster DCD		

Contributions

• A qualitative study of complex care teams

– Care coordination challenges

- Barriers to effective care plan implementation

Contributions

- A qualitative study of complex care teams
 - Care coordination challenges
 - Barriers to effective care plan implementation

• Defining "FLECS" teamwork characteristics

Contributions

- A qualitative study of complex care teams
 - Care coordination challenges
 - Barriers to effective care plan implementation

- Defining "FLECS" teamwork characteristics
- Foundations for technology design based on a computational teamwork theory

Study of Complex Care Teams

- Goal: understand care coordination challenges
- Interviews and observations of team members:
 - Parents (13)
 - Primary care providers (4)
 - Specialists (4)
 - Therapists (8)
 - Care coordinator (1)
 - Program directors (2)
 - Family services coordinator (1)
 - Social worker (1)
- Analyzed using affinity diagramming



Barriers to Effective Care Plan Use: Complex Teamwork in Complex Care

"FLECS" teamwork characteristics:

- Flat-structure of team
- Loosely coupled plans and activities
- Extended duration of plans
- Continual distributed revision of plans
- Syncopated time scales



Flat Structure

No single person in charge:

"We have different goals for different specialists; it is hard to keep track." (parent)

Need to prioritize goals because "everyone wants to work on everything." (parent)



Loosely Coupled Activities

Loose coupling makes appropriate information sharing hard:

"There isn't an example when I wasn't missing information" (specialist)

"We need to relay information back and forth..." (parent)



Extended Duration, Continual Distributed Plan Revision *No mechanism to support plan revision: Full-team meetings "totally not scalable"* (specialist)

"All the status chats have to be provider initiated, and so if you don't remember to do it or there's no one coordinating it, it's like where is it going, where do you even look for it?" (specialist)

Syncopated Time Scales

Different frequencies of seeing the patient

- Primary care providers: 3 to 4 times a year
- Specialists: 2 to 3 time a year
- Therapists: 1 to 3 times a week

Syncopated Time Scales

Different frequencies of seeing the patient

- Primary care providers: 3 to 4 times a year
- Specialists: 2 to 3 time a year
- Therapists: 1 to 3 times a week

Different information needs:

"A doctor asks if she is walking and expects a yes/no answer; a physical therapist will ask how she is walking and how much progress she has made." (parent)

• FLECS teamwork poses coordination challenges

- FLECS teamwork poses coordination challenges
- Principles for successful care plan use do not hold:
 - "The plan of care is systematized as a common, shared document; it is used consistently by every provider..."
 - "The team monitors progress against goals, provides feedback and adjusts the plan of care on an ongoing basis..."
 - "Family-centered care teams can access the information they need to make shared, informed decisions."

- FLECS teamwork poses coordination challenges
- Dringinlag for successful care plan use



information they need to make shared, informed decisions."

- FLECS teamwork poses coordination challenges
- Dringinlag for successful care plan use



How can technology better support such complex teamwork?

Technology for Supporting Teamwork

FLECS teamwork goes beyond prior work

- Supporting healthcare teams
 - Temporal coordination (Bardram 2000)
 - Centralized re-planning (Bardram 2010)
 - Mobile home care teams (Pinelle & Gutwin 2006)
- CSCW and social science teamwork theories and tools (Hutchins 1996; Star & Griesemer 1989; Hinds and McGrath 2006; Reddy & Spence 2008;...)

Foundations for Design of Systems to Support Complex Care Teams

SharedPlans (Grosz & Kraus 1996) :

A computational theory of collaboration



"...the capabilities needed for collaboration cannot be patched on but must be designed in from the start."













Current Systems: care plans are not integrated no adaptation of plan information

Current Systems: care plans are not integrated no adaptation of plan information

Opportunity for Technology Support: make care plan "ever-present" adapt presentation to team members









Current Systems: static, flat representation

Current Systems: static, flat representation

Opportunity for Technology Support: dynamic plan structure support revision and expansion





Current Systems: little organization and context information overload

Current Systems: little organization and context information overload

Opportunity for Technology Support: improved information sharing interfaces reasoning about team members' context

Key Roles for Technology for Supporting Complex Care Teams

- Make the care plan "ever present"
- Support plan revision and expansion
- Support efficient information sharing



Key Roles for Technology for Supporting Complex Care Teams

- Make the care plan "ever present"
- Support plan revision and expansion
- Support efficient information sharing

Challenges:

- Eliciting plans
- Inferring context in plan
- Reasoning about information sharing



Ongoing Work: GoalKeeper

Attend school	Increase school attendance. View this goal Dr. Seuss Mr. Edu	Pending Actions: Review material from last week on July 17, 2014	Recommendations: • Schedule appointment with Gl
Gain weight	Gain weight, aim to reach 60 pounds. View this goal Dr. Seuss Dr. Dorian John Doe Jane Doe	Pending Actions: Schedule appointment with GI on July 16, 2014	Update Bart's weight Add a Goal Goal nam e: Type: Better/Same/Worse
Seizure control	Understand seizure triggers and reduce number of seizures. View this goal Dr. Seuss Dr. House John Doe	Pending Actions: Lab test on July 17, 2014 Renew prescription on July 15, 2014	Description: Caregivers: • Dr. Seuss • Dr. House • Dr. Dotian • John Doe • Jane Doe • Mr. Edu Submit

Ongoing Work: GoalKeeper

Attend school	Increase school attendance. View this goal Dr. Seuss Mr. Edu	Pending Actions: Review material from last week on July 17, 2014	Recommendations: • Schedule appointment with Gl
Gain weight	Gain weight, aim to reach 60 pounds. View this goal Dr. Seuss Dr. Dorian John Doe Jane Doe	Pending Actions: Schedule appointment with GI on July 16, 2014	Update Bart's weight Add a Goal Goal nam e: Type: Better/Same/Worse
Seizure control	Understand seizure triggers and reduce number of seizures. View this goal Dr. Seuss Dr. House John Doe	Pending Actions: Lab test on July 17, 2014 Renew prescription on July 15, 2014	Description: Caregivers: • Dr. Seuss • Dr. House • Dr. Dotian • John Doe • Jane Doe • Mr. Edu Submit

Ongoing Work: Information Sharing Algorithms



Ongoing Work: Supporting Collaborative Writing

		it quite effective	ly, especially for	NPC problems - :	much mor
Formatted: Font: Italic, Complex Script Font: Italic, Highlight		We simply want to emphasize thi	ed to focus here o s point, also in th	on the <i>verification</i> e Discussion, else	aspect rat there will
Formatted: Highlight	Y//				
Formatted: Font: Italic, Complex Script Font: Italic, Highlight	Y//	Table 1: Experim	ent <u>al</u> results, showi of participants, show	ng <u>the</u> percentage o vn in brackets.	f subject <u>s</u> f
Formatted: Highlight	Y// /	THE SEMANT	ICS OF THE LE	FTMOST COLU	MN ARE
Formatted: Highlight	Y//#	THE DIFFERE	NCES AMONG 1	THE 2ND 3KD 4TH	5 TH ROV
Formatted: Highlight	¥///	A CLEAR DEF	INITION OF EAU	CH CASE IS CRU	See my e
Comment [YS12]: Captions of tables are typically above the table, as opposed to figures	Y///	[GIIII	GTIT:	VC
Formatted: Font: 9 pt, Complex Script Font: 9 ot	1//	P(solve) P(verify all)	0.05 (2) 0.11 (4)	0.56 (20) 0.58 (21)	0.49
Formatted: Font: 9 pt, Complex Script Font: 9 pt	1/	P(verify all incorrect solution)	0.08 (3)	0.19 (3)	0.46
Formatted: Font: 9 pt, Complex Script Font: 9 pt]/	P(verify others	0.22 (8)	0.44 (7)	0.76
Formatted: Superscript	Υ	solution)			
Comment [YS13]: This [c] seems very important; it is the capability to still distinguish right from wrong in OTHER people's arguments,		*P(verify own incorrect solution)	0.22 (8)	0.31 (5)	0.57
even when you are mistaken, and seems		N	38	36	7.
significantly higher (is it??) and, in particular, greater than 0.50, for the NPC problems. A similar argument could be made regarding [d].		•(a): The mean pro solver's own (b): The mean pro	bability of correctly solution?2 bability of correctly	v verifving all soluti « verifving all soluti	ons present
Both are relevant to the Discussion, since we want		(c): The mean pro	dability of correctl	v perifying solution	different :
to also say something meaningful regarding the claim that in the typical case. NPC problem solving is	own solution is		is incorrect??		
facilitated by larger groups, which converge	1 ///	(d); The mean pro	obability of correctl	v verifying [i.e., cla	ssifting as
towards a majority correct consensus, while PSC	1 ////	solver, given	that the solver's ow	in solution is incorre	ect ()
larger group, which (due to P(Sol) << 0.5, and P(VCS [Incorrect Own Solution]<0.5), converges	Our hypothesis predicts that subjects who were not al			able	
towards an incorrect majority solution	₹//// //	to solve the prob	elem on their own	, would be more l	ikely to
Formatted: Font: 9 pt, Complex Script Font: 9 pt, Highlight	JIIN	be able to verify than in the PSC	the proposed sol condition. The re	ution in the NPC of sults support this l	ondition:
Formatted: Font: 9 pt, Complex Script Font: 9 pt	MM	as we observe significantly lower verification rates among subjects who provided a wrong solution in the PSC			
Formatted: Indent: Before: 0", Hanging: 0.25"	M	= 0.56) was acts	le the success rate ally higher than t	in solving <u>G</u> TTT he success rate of	2 (P(solve solving V
Formatted: Font: 9 pt, Complex Script Font: 9 pt, Highlight		(P(solve) = 0.49), subjects posed with VC1 - and in particular those subjects who did not succeed at solving the problem - were significantly more likely (P = 0.46) to verify all presented solutions than subjects in the <u>GTTT2</u> condition (P 0.10). For VC2 which had a didbit higher success rate in			
Formatted: Font: 9 pt, Complex Script Font: 9 pt					
Formatted: Font: 9 pt, Complex Script Font: 9 pt, Highlight	M	solving the prob exhibits a simila	lem (P(Solve) = (r trend to that see	0.63), verification n in VC1 (P = 0.5	probabilit 4).
Formatted: Font: 9 pt, Complex Script Font: 9 pt]	The results for G of PSC problem	TTT1 also demo s, as it was verifi	nstrate the hard v ed correctly by on	erifiability ly 3 of
Formatted: Font: 9 pt, Complex Script Font: 9	1	the 36 subjects v of the 2 particin	who were not able	to solve it. More	over, one

Formatted: Highlight Formatted: Font: Italic Italic, Highlight

Formatted: Font: 9 pt, pt, Highlight

Formatted: Font: 9 pt, Complex Script Font:

sc P(solve) ving VC1 rticular em ion (P= e in bability ability of r, one failed at verifying one of the proposed solutions (stating that an

piects for each measure, along with the corre

0.77 (10)

0.54(7)

0.76 (26)

0.57 (20)

We looked at two measures that indicate that a paragraph may need attention. The first checked whether the related paragraphs underwent at least one significant change within the next ten versions

% indicating that a semantic discrepancy was introduced and required fixing.

The second measure tests whether the paragraphs continue to be edited together ten versions after the significant change, that is whether they change together (or remain unchanged together) more than half the time. This is a stronger indication than just undergoing at least one significant change

On average, 1.6 pPairs of paragraphs related by edit history were found on average 1.6 times per revision of the text. A pair related by topic similarity were only found once every ten versions. Proximity relationships always exist for each paragraphs as there are always neighboring paragraphs.

With respect to the first measure, the relationships of edit history and topic similarity are much more predictive of a future significant edit than proximity, as shown in Table~\ref(table:futureEdits}. They are also significantly more predictive than random sample controls. We compare with the original paragraph as well as a random sample of any ten consecutive versions within Wikipedia article histories.

\begin{table}			
\small			11:22 AM Today
<pre>\begin{tabular}{ p{5cm} p{5c</pre>	m} }		Delete: "on average 1.6 times"
\hline			
<pre>\textbf{Relationship}</pre>	& Percentage of times there e	xists	Ofra Amir 8-22 PM Dec 22
at least one significant cha	nge} \\ \hline		do up have the sumber for this?
Edit History	8	81\%	do we have the number for this?
\\ \hline			Sebastian Gehrmann 11:21 AM Today
Proximity	8	24\%	I'm working on it

laurenurke

2 grosz

you mean

11:22 AM Today

4-03 DM Det 24

laurenurke 12:00 PM Dec 31

grosz 4:09 PM Dec 31

Not really. Do you mean that "On

average 1.6 pairs of paragraphs related by edit history were found per revision" (i.e., somewhere between

is this clearer?

Replace: "P" with "On average, 1.6 p"

1.6 times per version? not clear what

Come check out our WiP poster today Deploying AI Methods to Support Collaborative Writing: a Preliminary Investigation Gehrmann, Urke, Amir and Grosz, 2015

Conclusion

- Qualitative study of complex care teams
- Identifying FLECS teamwork characteristics
- Foundations for technology design from computational teamwork theories
- Ongoing work toward designing such systems...

Ofra Amir, Barbara Grosz, Krzysztof Gajos Harvard School of Engineering and Applied Sciences Sonja Swenson, Lee Sanders Stanford University